SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XX APRIL, 1915 NUMBER 4

THE FUTILITY OF ARTERIOVENOUS ANASTOMOSIS IN THE TREATMENT OF IMPENDING GANGRENE OF THE LOWER EXTREMITY

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IN the course of some investigations in the treatment of diabetic gangrene of the lower extremity, I became interested in that operative procedure variously known as arteriovenous anastomosis, the Wieting operation, or reversal of the circulation. This consists in a laterolateral (generally with proximal ligature of vein), terminolateral (artery to vein or vein to artery), or terminoterminal anastomosis usually between the femoral artery and femoral vein. This operation was first attempted in the human by the Spanish surgeon, San Mártin y Satrústegui in 1902, although unsuccessful experimental attempts had been made as early as 1881 by François-Franck, and in 1896 by Petit. It was popularized by Wieting of Constantinople in 1908 and it has since found numerous supporters, notably Bernheim of Baltimore and, very recently, Goodman of New York. From the experimental standpoint Carrel has been its most prominent sponsor.

The fundamental principle on which this operation is based is very obvious. In cases of gangrene, or rather of threatened gangrene of the lower extremity, due to imperfect arterial circulation, an anastomosis between the femoral artery and femoral vein should permit a flow of blood through the latter and thus preserve the nutrition of the limb. The advocates of the operation all claim that this is possible and insist that the venous valves offer no permanent barrier to the pressure of the arterial system.

In the hope of applying this operative procedure to suitable cases, I devoted some time to a study of the subject, and, after a careful perusal of the literature, became very doubtful as to the physiological and anatomical soundness of the operation. In spite of considerable evidence that has accumulated that this so-called reversal of the circulation is not only an unsatisfactory but also a somewhat dangerous operation, it is, nevertheless, still extensively utilized, and there are indications that it is even becoming more popular. As far back as 1903, Gallois and Pinatelle showed that after the injection of colored liquids into the femoral vein, the liquids returned at once through the adjacent tributaries and that when these were clamped there was no flow into the vein. They believed, however, that in advanced age and in certain diseased conditions of the veins the obstruction on the part of the valves was less certain.

In 1911 Coenen and Wiewiorowski published an admirable critical study of the entire subject and came to the conclusion that the operation was not only thoroughly unsound, but actually dangerous. These investigators, in a number of preliminary experiments, found that it was not possible

to obtain a permanent result with an arteriovenous anastomosis and that a thrombosis or an obliteration invariably followed the operation after a certain length of time. These results coincided with those of San Mártin y Satrústegui, Vignolo, Exner, Höpfner, and Stich, Makkas and Dowmann. Coenen and Wiewiorowski were unable to verify the successful experimental results of Carrel, Morel, Guthrie, Watts, Tuffier, Frouin, and Hadda. In attempting to reverse the circulation in the leg of a dog, they found, by direct observation, that the valves of the veins could be only partially forced and that anything like a complete reversal was out of the question. They also attempted a reversal in the kidney circulation, where there are no venous valves; here they were likewise unsuccessful. They further performed arteriovenous anastomoses in dogs at points where ligation of the large vessels resulted either in death of the animal or necrosis of the extremities. In each instance the anastomosis had the same effect as a ligation; in other words, the operation was only successful when collateral arterial circulation was still possible. They next attempted retrograde injection of the kidney vein with colored fluid and could not force this fluid into the arterial system. They connected a Huerthle stromuhr with artery and vein and were unable to obtain a flow. They then performed numerous cadaver experiments in human and animal cadavers as to the possibility of retrograde injection of the larger veins. The results of this series showed that the venous valves prevented a flow toward the periphery, even when great pressure was used. They finally analyzed the hitherto published results of the operation in the human and found in 35 cases 30 absolute failures, cases which either resulted fatally or which required eventual amputation.

In a later paper Coenen added more experimental data supporting his views, and Hauke substantiated these claims by some further experimental work. Rothmann, in a series of very beautiful experiments, then studied the question by directly observing the capillary circulation in the mesentery and web of the foot of a frog. He concluded that if there were valves in the veins there was absolutely no possibility of reversal. If there was one vein without a valve a certain amount of reversal was possible. From 2 to 5 per cent of the injected liquid went through the capillaries, but this retrograde injection was accompanied by excessive œdema. If there was more than one vein without a valve a very small percentage might go through the capillaries, but the main return flow was through the venous anastomosis. The conclusions of Coenen have also been verified by Fedorowitsch.

On account of the diversity of the experimental and clinical results of various investigators and especially because of the optimism expressed by many, notwithstanding the above-mentioned unfavorable conclusions, I determined to satisfy myself by some personal study as to the utility of arteriovenous anastomosis in cases of impending gangrene of the lower extremity due to arterial obstruction. I wished to devise a method of imitating, in the experiment, the conditions present when such an operation might be indicated. My aim was to find some way of graphically recording the amount of arterial circulation possible through venous channels and I called upon the X-ray as an aid. I felt that, by using lower extremities, freshly amputated, in cases of gangrene due to arteriosclerosis or other arterial disease and variously injecting these with liquids impenetrable to the röntgen ray, I would obtain radiographic pictures that might throw some light on the subject. It was, of course, essential that the injection be performed with a pressure equal to, or exceeding, a high blood-pressure. There was some difficulty in finding the proper liquid for the purpose, but after a few attempts with collargol and neutral lead acetate solutions, I finally adopted an emulsion of red oxide of lead in paraffin oil, equal parts. A somewhat similar emulsion has been recommended by Hauch, who used it in studying radiographically the arterial system of the kidneys. I had originally intended to utilize a continuous gravity method for the injection so that the pressure would correspond to about 250 mm. of mercury; but

as this was only applicable with solutions, I later adopted a hand syringe.

In general, the technique was as follows: The vascular system of the freshly amputated limb was thoroughly irrigated with saline solution through the artery. There was not the slightest difficulty in obtaining a prompt return of fluid through the vein. Incidentally, it was never possible to force the fluid to run through the vein in a backward direction. When the blood was entirely washed out, the vein was injected. When the hand syringe was used, the injection was made intermittently in imitation of the heart beat. It was continued for some time, usually about thirty minutes, and was made with considerable force. Leaking tributaries were clamped and ligated. The vein, which invariably became enormously distended in its visible portion, was then tied off and the limb radiographed. In some of the experiments I then removed the ligature from the vein and injected the artery with the same material and in the same way, in order to obtain an arterial injection for comparison with the venous injection in the same extremity, and incidentally to study the arterial circulation in these cases of gangrene due to arteriosclerosis or other arterial obstruction. The particular advantage of the red oxide of lead emulsion in these arterial injections was that the lead was arrested at the capillaries and did not diffuse into the tissues, while the paraffin oil separated from the emulsion in the capillary network and washed out the previously injected vein. Leaking branches were clamped and ligated, the artery was tied off, and the extremity was radiographed again. The gangrenous limbs that were used were all from cases with more or less marked arteriosclerosis or, at least, arterial occlusion and apparently normal veins.

Although the material at my disposal has not been extensive, I believe it is sufficient to draw certain conclusions and I feel that the results are interesting enough to warrant publication. Therefore, without further comment, I beg to submit the following experimental data:

Experiment No. 1. G. Z., 1140–1914, male, age 39. Amputation at junction of upper and middle third of left leg for diabetic gangrene of plantar region, first and third toes; second toe missing. No dorsalis pedis, posterior tibial, or popliteal pulse felt. Marked calcareous degeneration of the arteries. Veins normal. Injection of a 10 per cent collargol solution into the anterior and posterior tibial veins by gravity method at 3 m. for 18 hours. The main leaking tributaries were clamped and ligated. About 350 ccm. of fluid were used, a good portion of which apparently ran out through smaller collaterals which were not clamped. The veins were tied off.

Radiographic examination of the injected limb (Fig. 1) shows a certain amount of circulation of the injecting fluid, particularly in the middle third of the leg. The anterior and posterior tibial veins, especially the latter, are well injected for 3 to 4 cm. and a number of the smaller collaterals show the presence of the injecting fluid. The internal plantar vein and the venous plantar arch and digital tributaries show traces of the injecting fluid, but there is no real capillary circulation, although some of the smaller venules are injected. The region of the ankle shows relatively little injection. In some places the injecting fluid stops abruptly in the veins, forming slight bulbous enlargements.

Experiment No. 2. W. P., 1139–1914, male, age 74. Amputation at junction of middle and lower third of right thigh for diabetic gangrene of outer side of foot involving fourth toe; fifth toe missing. No dorsalis pedis or posterior tibial pulse felt. Popliteal pulse felt. Moderate calcareous degeneration of artery. Vein normal. Injection of a 20 per cent neutral lead acetate solution into the popliteal vein by gravity method at 2.8 m. for 44 hours. The main leaking tributaries were clamped and ligated. About 420 ccm. of fluid were used, some of which ran out of smaller collaterals which were not clamped and some of which diffused through the amputation wound. The popliteal vein was tied off.

Radiographic examination of the injected limb (Fig. 2) shows a diffusion of the injecting fluid in the popliteal region extending down the leg to the junction of the middle and lower third but mainly in the upper third. There is no evidence of the injecting fluid in the neighborhood of the ankle or in the foot. There is no sign of any capillary circulation. There is a visible calcified anterior tibial artery at the ankle.

In all of the subsequent experiments the injection was made with a hand syringe, and a 50 per cent emulsion of red oxide of lead in paraffin oil was used. The injection was made intermittently. Leaking tributaries or branches were clamped and ligated, and the vein or artery tied off.

Experiment No. 3. M. L., 1048–1914, male, age 44. Amputation at junction of upper and middle third of left thigh for recurrent sarcoma of

lower third of femur with spontaneous fracture. Vessels normal. Previous to the amputation there was a continuous venous hæmorrhage, due probably to an erosion or puncture by a bone spicule of a main venous trunk. Forcible injection of the femoral vein.

Radiographic examination of the injected limb (Fig. 3) shows the presence of the injecting fluid extending into the popliteal vein to a point just below the knee-joint, corresponding to the region where the anterior and posterior tibial veins unite. The fluid terminates abruptly in several bulbous enlargements. There is some injection of the smaller tributaries of the femoral vein. A large mass of the injection material apparently fills the old wound cavity. This is doubtless the result of a leakage through the opening in the vein that bled *intra vitam*. There is no evidence of any capillary circulation or of any injecting fluid below the tuberosity of the tibia.

Experiment No. 4. G. S., 2852–1914, male, age 52. Amputation at junction of middle and lower third of right thigh for diabetic gangrene of outer side of foot; fifth toe and fifth metatarsal missing. No dorsalis pedis or posterior tibial pulse felt. Popliteal pulse felt. Rather marked arteriosclerosis. Vein normal. Forcible injection of the popliteal vein.

Radiographic examination of the injected limb (Fig. 4) shows a marked dilatation of the popliteal vein down to a short distance below the knee-joint at a point corresponding to the junctions of the anterior and posterior tibial veins. The beginning of the posterior tibial vein is also distended and there is a trace of the injection material running a short distance down into this vein. The anterior tibial vein contains injection material in the upper third of the leg to a point 12 cm. below the knee-joint, but then the injection stops more or less abruptly. Some tributaries show distinct blocking by valves just near the junction with the main vein. There are a few scattered particles of the injection material in the middle third of the leg and a tributary of the lower part of the popliteal shows an injection for a short distance from the main trunk. There is absolutely no evidence of any capillary circulation, and the lower part of the leg and the foot are entirely devoid of any injection. Calcified anterior and posterior tibial arteries are visible, especially at the ankle.

Experiment No. 5. Same extremity as Experiment No. 4. After removal of the ligature from the injected popliteal vein, the popliteal artery was injected. It was particularly noticeable that the liquid flowed into the artery much more easily than into the vein. The red oxide of lead emulsion which had been injected into the vein gradually flowed out under the pressure of the arterial injection and eventually came out clear paraffin oil.

Radiographic examination of the injected limb (Fig. 5) shows an injection of the entire arterial system of the extremity. Considering the marked arteriosclerosis, it is astonishing to observe how relatively perfect this injection is. The main trunks, especially the peroneal, show slight interruptions. The dorsalis pedis artery is not in evidence below the midtarsal region. In its lower portion the posterior tibial artery is somewhat thinned. In the dorsal region of the foot, in the toes, and in the posterior part of the heel, the circulation is defective, but in the rest of the extremity the capillary network is unusually well demonstrated, even in the peripheral portions. The veins are entirely empty. In the foot are seen blotches of injection material due to leakage through the old wound.

Experiment No. 6. O. B., 3951–1914, female, age 61. Amputation at junction of middle and lower third of right thigh for diabetic gangrene of plantar region; second toe gangrenous; third toe missing. No dorsalis pedis or posterior tibial pulse felt. Popliteal pulse felt. Rather marked calcareous degeneration of artery. Double vein, walls normal. Very forcible injection of larger vein (posterior tibial). Excessive pressure was used.

Radiographic examination of the injected limb (Fig. 6) shows a mass of injection material filling the popliteal space and extending nearly to the middle of the leg. The vein has been ruptured by the excessive pressure used in the injection and the injecting fluid has escaped into the tissues. There is a slight injection of a few tributaries anteriorly and posteriorly, but there is no evidence of capillary injection and no injection material is visible below the middle of the leg. Several calcareous arteries are seen, especially the posterior tibial at the ankle.

Experiment No. 7. Same extremity as Experiment No. 6. After removal of the ligature from the injected posterior tibial vein, the popliteal artery was injected. The injection was made with considerably less force than was used to inject the vein.

Radiographic examination of the injected limb (Fig. 7) shows a fair arterial injection of the extremity. The old mass from the venous injection and rupture is naturally still present. The popliteal and anterior tibial artery down to the lower third of the leg are fairly normal. At this point there are a number of interruptions and just above the ankle-joint the anterior tibial artery stops abruptly. The posterior tibial artery is imperfectly injected, but at the ankle it is seen considerably reduced in lumen. The peroneal and dorsalis pedis arteries are not injected. Some of the digital vessels are injected, but altogether the injection of the foot is poor. The capillary injection of the limb is moderately good, especially in the middle and lower thirds of the leg.

Experiment No. 8. M. H., 5289–1914, male, age 51. Amputation at junction of middle and lower third of right thigh for diabetic gangrene of foot, especially first and second toes and plantar region; third, fourth, and fifth toes missing. No dorsalis pedis, posterior tibial, or popliteal pulse felt.

Very extreme calcareous degeneration of arteries. Veins normal. A microscopic examination of the popliteal vein and artery shows the vein to be absolutely normal, while the lumen of the artery is reduced about 50 per cent by a fibrous and calcareous deposit in the intima. Forcible injection of the popliteal vein.

Radiographic examination of the injected limb (Fig. 8) shows a distention of the popliteal vein and of the beginning of the anterior and posterior tibial veins. The injection ends abruptly just below the knee-joint. One injected tributary of the popliteal is lying in front of the vessel. There are slight traces of the injecting fluid in the upper third of the leg. There is no capillary injection and there is no injection material seen below the junction of the upper and middle third of the leg. A calcareous anterior tibial artery is visible.

Experiment No. 9. Same extremity as Experiment No. 8. After removal of the ligature from the injected popliteal vein, the popliteal artery was injected. The injection was made with much less force than was used to inject the vein. The injection was continued until fairly clear paraffin oil flowed from the popliteal vein.

Radiographic examination of the injected limb (Fig. 9) shows an extensive injection of the entire extremity. The anterior tibial and dorsalis pedis arteries can be traced down to the metatarsal region; they are fairly normal in size and the injection is practically uninterrupted. What seems to be the posterior tibial artery is seen injected for about 3 cm., but the main branch is apparently obstructed or, at least, is not visible in the middle, in the lower part of the leg, or in the ankle. There are, however, numerous unusually large collateral branches seen in the calf. The peroneal artery is not injected. The capillary injection is remarkably good and extends down into the toes. There are traces of the injecting fluid still seen in the popliteal vein.

Experiment No. 10. W. R., 6126–1914, male, age 26. Amputation at junction of middle and lower third of left thigh for presenile gangrene (thromboangiitis obliterans, or possibly Raynaud's disease) of foot involving all the toes to the metatarsal region. No dorsalis pedis, posterior tibial, or popliteal pulse felt. The popliteal vein is normal, but the popliteal artery is an exceedingly small, cordlike strand firmly imbedded in fibrous tissue. The lumen is partially obliterated by what appears to be an organized thrombus. A microscopic examination of the popliteal artery shows an organized but partially canalized thrombus attached at one point to the intima and reducing the lumen of the very small artery at least 50 per cent. Forcible injection of the popliteal vein.

Radiographic examination of the injected limb (Fig. 10) shows a distended popliteal vein, the injection of which ends abruptly about 5 cm. down just below the knee-joint, in a bulbous enlargement. Several larger and smaller tributaries in the popliteal space are injected, but the larger of these all show abrupt terminations with bulbous dilatations. There is a trace of the injecting fluid a little below the injected vein, but no injection material is seen below the tuberosity of the tibia. There is no evidence of any capillary circulation.

Experiment No. 11. Same extremity as Experiment No. 10. After removal of the ligature from the injected popliteal vein, the popliteal artery was injected. A little difficulty was experienced in inserting the cannula into the artery on account of the obstruction of the lumen by the organized thrombus, but, when once the cannula was in proper position, the injecting fluid flowed freely and much less force was used than with the injection of the vein. The injection was continued until clear paraffin oil returned through the popliteal vein.

Radiographic examination of the injected limb (Fig. 11) shows a remarkably good circulation even to the smallest capillary and down to the gangrenous metatarsal region. The anterior and posterior-tibial and peroneal arteries are well injected, although somewhat narrow. The dorsalis pedis is not injected. In the upper and middle third of the leg the circulation is exceptionally good. In fact, the injection of the capillary system is so dense that the outlines of the main vessels and of the bones are somewhat obscured. The nutrient vessels of the femur can also be distinguished. Some of the injecting fluid is seen spread over the gangrenous area, evidently leaking through the wound in the foot. Some traces of the venous injection are still seen.

Experiment No. 12. J. M., 6012–1914, male, age 63. Amputation at junction of upper and middle third of right leg for senile gangrene of second and third toes. No dorsalis pedis or posterior tibial pulse felt. Popliteal pulse felt. Very extreme calcareous degeneration of arteries. Veins normal. Forcible injection of larger posterior tibial vein. Prompt leakage through a large tributary was especially noticeable.

Radiographic examination of the injected limb (Fig. 12) shows the posterior tibial vein distended with the injecting fluid for 2 cm. The injection ends abruptly. A large tributary behind the vein is also filled up to the amputation wound. A few smaller tributaries in the immediate vicinity show traces of the injection material, but there is no further injection in the leg or foot. There is no evidence of any capillary circulation. In the middle third of the leg a calcareous posterior tibial artery is visible and in the anterior part of the ankle a calcareous anterior tibial artery is seen.

Although the anterior and posterior tibial and peroneal arteries were patent, the lumen was so narrowed and the atheromatous degeneration so extreme that efforts to insert the cannula for injection had to be abandoned.

Experiment No. 13. Same patient as Experiment No. 12. Re-amputation at middle of right thigh for gangrene of flaps after amputation at

junction of upper and middle third of leg for senile gangrene. Very advanced calcareous degeneration of artery. Vein normal. Forcible injection of femoral vein. It was particularly noticeable how promptly the injected fluid returned through two larger tributaries.

Radiographic examination of the injected specimen (Fig. 13) shows the femoral and popliteal vein well injected for a distance of 12 cm. or to a point corresponding to the level of the knee-joint. There is a distinct bulbous enlargement at the termination of the injection of the vein; into this dilated end run two tributaries, apparently the anterior and posterior tibial veins, the former injected for about 3 cm. and the latter 2 cm. Two large collaterals, one running in front of the main trunk and one behind it, are injected up to the amputation wound. Several large anastomotic branches join these two tributaries; the posterior tributary is likewise connected to the posterior tibial vein by a fine anastomotic vessel. Behind this posterior tributary there is a fine venous anastomosis and there is another anastomosis anterior to it, just below the amputation wound. Anterior to the femur, just below the amputation wound, a few small tributaries are injected. Along the larger veins are occasional bulbous protuberances, evidently the endings of other tributaries obstructed by valves. There is no evidence of any capillary circulation. Below the knee-joint the calcareous popliteal artery is visible down to and including its bifurcation into the anterior and posterior tibial arteries. Posterior to this a smaller calcareous artery can also be seen.

Experiment No. 14. Same extremity as Experiment No. 13. After removal of the ligature from the injected femoral vein, the femoral artery was injected. The injection was made with much less force than was used to inject the vein. Considerable material promptly ran through the wound at the end of the stump.

Radiographic examination of the injected specimen (Fig. 14) shows an excellent arterial injection. The femoral and popliteal artery, continued down into the anterior tibial, is well injected up to 2 cm. above the end of the stump. The lumen is distinctly narrowed. The posterior tibial artery is not injected at the bifurcation, although near the wound at the stump, it contains a small amount of injecting material. Several large collateral branches are seen at the beginning of the artery and also at the knee-joint. The capillary system is very well injected. A large portion of the venous injection is still visible.

Experiment No. 15. M. K., 6997–1914, female, age 50. Inter capulothoracic amputation of left upper extremity for recurrent sarcoma of humerus and shoulder. Vessels normal. By mistake a large vein was taken for the axillary and injected. This vein was later found to be the cephalic, and to correct the error as much as possible of the injection material was expressed. The axillary vein was then forcibly injected.

Radiographic examination of the injected limb (Fig. 15) shows traces of the injecting fluid in the cephalic vein down to the junction of the upper and middle third of the arm. The axillary vein is well injected down to almost the middle of the arm where it stops abruptly. A large tributary, evidently the subscapular, is well injected to a point corresponding to the midscapular region where it terminates in an anastomotic network. Numerous smaller tributaries in the immediate vicinity of the main trunks are injected and apparently anastomose with one another. There is a trace of injection material in the lower third of the arm but none is seen in the forearm, hand, or fingers. At several points along the larger veins are bulbous protuberances, clearly the entrances of tributaries obstructed by valves. There is no sign of any capillary injection.

Experiment No. 16. Same extremity as Experiment No. 15. After removal of the ligature from the injected axillary vein, the axillary artery was injected. Much less force was used than with the venous injection and injection was continued until fairly clear paraffin oil flowed from axillary vein.

Radiographic examination of the injected limb (Fig. 16) shows a splendid arterial and capillary injection of the entire extremity to the finger tips. In the middle of the arm, anterior to the humerus, is seen a mass of injection material which has escaped into the tissues due to rupture of a small vessel. The sarcomatous condition of the tissues probably accounts for the friability of the vessel. Traces of the venous injection are still visible.

Experiment No. 17. N. K., 7015–1914, male, age 35. Amputation at junction of middle and lower third of right thigh for gangrene of outer side of dorsum of foot and of heel due to thromboangiitis obliterans; fourth and fifth toes missing. No dorsalis pedis, posterior tibial, or popliteal pulse felt. Artery is a small, cordlike strand embedded in fibrous tissue and almost entirely occluded by a firm, organized thrombus. Vein normal. Forcible injection of popliteal vein.

Radiographic examination of the injected limb (Fig. 17) shows the injection material filling the popliteal vein and extending down rather farther than usual into what appears to be the posterior tibial vein. This latter vein is well filled in the upper third of the leg and traces of the injection are seen in the vein as far down as the middle of the leg. A few tributaries of the popliteal are injected. Some lie in front of the vein, and some are seen behind it just below the amputation wound. There are a few bulbous projections along the injected vein. One is particularly prominent anteriorly about 7 cm. below the knee-joint. These projections are undoubtedly tributary openings blocked by valves. There is absolutely no trace of any capillary injection and no injection material is seen below the middle of the leg.

Experiment No. 18. Same extremity as Experiment No. 17. After removal of the ligature from

the injected popliteal vein, the popliteal artery was injected. In spite of the fact that the artery was very small and almost entirely occluded by an organized thrombus, after the cannula was in proper position the injecting fluid flowed freely and much less force was used than when the vein was injected. The injection was continued until fairly clear paraffin oil returned from the popliteal vein.

Radiographic examination of the injected limb (Fig. 18) shows a fair arterial injection of the extremity. The main trunk of the popliteal artery shows several interruptions. The anterior tibial is seen in the lower half of the leg very much narrowed. It is continued into the dorsalis pedis, also much narrowed, up to the tarsometatarsal junction where it stops rather abruptly. The posterior tibial artery is only visible at the internal malleolus. It is of very small caliber. There are several large collateral branches, especially one above and one below the knee-joint anteriorly, and one posteriorly running almost the entire length of the leg and situated quite superficially. The peroneal artery is not injected. The capillary injection around the knee and in the upper half of the leg is good. It is not good in the lower half of the leg and it is very poor in the tarsal and metatarsal regions and in the heel. The toes, however, show a very passable capillary injection. Remnants of the venous injection are still visible.

Although, of course, it must be conceded that the results of these experiments are not absolutely conclusive, I feel that they are very significant. What conclusions can one draw from a study of the experimental data? The most obvious fact is that, with one exception (Experiment No. 1 and Fig. 1), there is no flow to any extent through the vein toward the periphery and that there is no evidence of any capillary circulation after venous injection. The valves, judging by the bulbous terminations of the injected vessels, are apparently the cause of the obstruction. It is certainly evident that this obstruction cannot be entirely overcome even by extreme force, for it is clear from the radiographs that the veins are distended almost to the bursting point and that even in one instance, where excessive force was used and the vein ruptured (Experiment No. 6 and Fig. 6), there is no sign of any peripheral circulation through the venous channels. I confess that I am somewhat at a loss to explain the exceptional result in Experiment No. 1. I cannot account for it by the fact that the injection was made through the smaller veins, since in Experiment No. 12 an injection was also made of a smaller vein and the result was quite similar to those when the larger veins were injected. It is possible that the valves in these veins were less resistant. Even in this case, however, although it is true that the injecting fluid does reach the foot, it does not circulate to the capillary tributaries. One fact stands out preëminent and that is that when the larger vein of the thigh is injected the fluid can be forced only for a short distance into the main trunk and into a few immediate tributaries in which and in their anastomoses the flow is central. One or two sets of valves may be overcome, but eventually, usually just below the level of the knee-joint, the obstruction is insurmountable.

Since the completion of the above series of experiments, I have learned that Wiewiorowski, the former collaborator of Coenen, has independently come to practically the identical conclusions in regard to the retrograde venous circulation. They are based on radiographic studies of iodipin injections into the veins of living and dead animals. In the one experiment on the upper extremity which I had the opportunity of performing (Experiment No. 15 and Fig. 15), entirely similar conditions prevailed.

In the second type of experiment, namely, the injection of the arterial system of the same extremity in which the vein had been injected previously, a startling fact is brought out. In even much more advanced cases than those in which arteriovenous anastomosis might possibly be indicated, no matter how extensive the gangrene or how diseased the artery may be, there is a relatively perfect arterial circulation down to the minutest capillary in those portions of the limb that are not already gangrenous. If a main artery is obstructed an ample collateral circulation seems to form (Fig. 9). Not only are these facts clear, but it is likewise true that much less force is needed to produce an excellent arterial and capillary injection than was used to produce the imperfect venous injection.

I appreciate that the familar argument will be advanced against these experiments that the injection is not analogous to the conditions

TABLE OF CASES OF ARTERIOVENOUS ANASTOMOSIS

DEATHS AFTER OPERATION

1. Tuffier, 1907. M. 56
2. Lilienthal, 1907. M. 20
3. Hubbard, 1909. M. 77
4. Celesia, 1909. F. 52
5. Imbert (also Fiolle), 1909. M.
6. Enderlen, 1910. M.
7. Schmieden, 1910. F. 48
8. Tietze, 1910. F. 69
9. Goldenberg (Tietze), 1910. M. 64
10. Payr, 1910. M. 70
11. F. Müller, 1910. M. 63
12. Slawinski, 1910. M. 62
13. Mauclaire, 1910. M. 72
14. Mauclaire, 1910. F. 71
15. Viannay, 1910. F. 52
16. C. Beck (Halstead and Vaughan), 1911
17. Halstead, 1911. F. 64
18. Gottstein (Coenen and Wiewiorowski), 1911
19. Gottstein (Coenen and Wiewiorowski), 1911
20. Gottstein (Coenen and Wiewiorowski), 1911
21. Mantelli, 1911. M. 51
22. Luxembourg, 1912. M. 55
23. Wieting, 1912. M. 60 (Upper extremity)
24. Zesas, 1912
25. D'Oria, 1913
26. D'Oria, 1913
27. D'Oria, 1913
28. Kerr, 1914. F. 62
29. Vaughan (Neuman), 1914
30. G. P. Müller, 1914 (Personal communication)

DEATHS FOLLOWING AMPUTATION

1. Satrústegui, 1902. M. 52
2. Jaboulay (also Lecercle), 1902, (also Gallois and Pinatelle, 1903). M. 47
3. Jaboulay (Charnois), 1908. M. 43
4. Jaboulay (Monod and Vanverts), 1910. M. 67
5. G. P. Müller, 1910. M. 51
6. Mauclaire, 1910. F. 73
7. Mauclaire, 1910. F. 66
8. Halstead, 1911. M. 62
9. Morozoff, 1912. M. 79
10. Goodman, 1914. M. 52
11. Dawbarn, 1915. M. 65 (Personal communication)

AMPUTATIONS

1. Hubbard, 1906. M. 80
2. Hubbard, 1907. F. 60
3. Torrance, 1907. M. 40
4. Hubbard, 1908. F. 84
5. Lund, 1908. M. 32
6. Ohran (Wieting), 1908
7. Abalos, 1909. M. 62
8. Imbert (also Lacroix), 1909. M. 25
9. Armour and Smith, 1909. M. 69
10. Wieting, 1909. M. 35
11. Enderlen, 1910
12. Jaboulay (Monod and Vanverts, 1910. M. 66
13. Bier (also F. Müller), 1910. M. 38
14. Slawinski, 1910
15. Riedel (also Krüger, 1910), 1911, F. 48
16. Krause (Quénu), 1911. M. 48
17. C. Beck (also Halstead and Vaughan), 1911. M.
18. Coenen, 1911. M. 51
19. Wieting, 1911. M. 33
20. Ohran (Wieting), 1911
21. Ohran (Wieting), 1911. M. 40
22. Greiffenhagen, 1911. M. 33 (Upper extremity)
23. Wieting, 1912. M. 40
24. Hesse, 1912. M.
25. Bernheim, 1912. M. 40
26. Norbury, 1912. M.
27. Bogoraz, 1912. M. 32
28. Morozoff, 1912. M. 31
29. Morozoff, 1912. M. 27
30. Zawadski, 1912
31. Freeman, 1913. M. 39
32. Goodman, 1913. M. 28
33. Goodman, 1913. M. 41
34. Goodman, 1913. M. 45
35. Goodman, 1913. M.
36. Goodman, 1913. M.
37. Goodman, 1913. F. 87
38. Goodman, 1913. M. 35
39. Goodman, 1913. M. 38
40. Nassetti, 1913. M. 62
41. Putnam, 1915. M. 30
42. Buerger, 1915. M. 42 (Personal communication)
43. Buerger, 1915. M. (Personal communication)
44. Bernheim, 1915. M. 46
45. Bernheim, 1915. M. 63

OPERATIONS ABANDONED ON ACCOUNT OF CONDITION OF VESSELS

1. Schmieden, 1910. M. 29
2. Schmieden, 1910. M. 61
3. Ohran (Wieting), 1911
4. Unger, 1911
5. Unger, 1911
6. Greiffenhagen, 1911. M. 33 (Upper extremity)
7. Hesse, 1912
8. Hesse, 1912
9. Goodman, 1913. M. 31
10. Goodman, 1913
11. Goodman, 1914 (Personal communication)
12. G. P. Müller, 1914. M. (Personal communication)

NEGATIVE OR DOUBTFUL CASES

1. Satrústegui, 1902. M. 76
2. Tuffier (Cottard), 1907. M. 50
3. Coenen, 1911. F. 55
4. Bernheim, 1912. M. 27
5. Bernheim, 1912. F. 61
6. Bernheim, 1912. M. 52 (Upper extremity)
7. Tilton, 1915. M. (Upper extremity)
8. Grant, 1915. M. 38 (Personal communication)

SUCCESSES IN UPPER EXTREMITY

1. Doberauer, 1907. F.
2. Heymann, 1911. M. 47
3. Wieting, 1912. M. 24
4. Bernheim, 1913. F. 27
5. Bernheim, 1913. F. 27
6. Neal, 1914. M. 53

SUCCESSES IN LOWER EXTREMITY

1. Wieting, 1908. M. 40
2. Ballance, 1908. F. 75
3. J. B. Murphy, 1909, (also Binnie, 1910)
4. Wieting, 1911. M. 40
5. Wieting, 1911. M. 32
6. Glasstein, 1911. M. 38
7. Bernheim, 1912. F. 27
8. Bernheim, 1912. F. 27
9. Davies, 1912. M. 46
10. Goodman, 1912. M. 35
11. Goodman, 1913. M. 21
12. Goodman, 1913. M.
13. Goodman, 1913. M.
14. Goodman, 1913. M. 35
15. Perimoff, 1913. M. 28
16. McWilliams, 1913. M. 53
17. Thomson, 1913. F.
18. Thomson, 1913. F.
19. Porta (also D'Oria), 1913
20. D'Oria, 1913
21. Vaughan, 1913. M. 65
22. Meyer, 1914. M. 29
23. Lilienthal, 1914. M. 44
24. Lilienthal, 1914. M. 54

created by an arteriovenous anastomosis in life. It will be said that the intermittent but constant pounding of the heart and the continuous pressure of the arterial system will gradually break down the obstruction offered by the venous valves and that this pumplike action can with difficulty be imitated. It will also be said that the adaptability of the tissues in the living organism is much greater than in even the fresh cadaver. It is my intention to carry out a series of animal experiments to determine the validity of these contentions. One conclusion, however, is certain, namely, that in that type of condition where arteriovenous anastomosis might be indicated, in gangrene or threatened gangrene due to arterial occlusion from angiosclerosis or allied lesions, the flow through the pathological arterial system is immeasurably better and easier than it could possibly be through the relatively healthy venous system, no matter how extreme the arterial disease may be.

It will be noted that I have laid stress only upon the question of the comparative extent of the peripheral flow through the more or less normal vein and the obstructed artery. I have not as yet considered the problem of the return flow. As will be seen from the experiments, the return flow through the veins when the arterial system was irrigated or injected was comparatively normal. In no instance could any return flow be obtained through the artery upon irrigation or injection of the vein. To be sure, when the vein was injected there was usually a certain amount of very prompt leakage through immediate adjacent collaterals, but this was more like a short-circuiting than a return flow from the periphery (Figs. 12 and 13).

One further point should be emphasized, namely, that the veins in my cases were all patent. If the venous circulation is relatively so poor through patent veins, how much worse must it be through occluded or partially occluded veins, so often found in certain types of these cases?

Summarizing these experiments, it will be seen that—

1. A peripheral flow through the patent veins in cases of gangrene due to vascular disease is only possible to a very slight extent. The valves are eventually an impassable barrier, even when the injection is made with extreme force.[1] There is never any capillary circulation.

2. Even if the arteries are extensively diseased, the arterial circulation to the smallest capillaries is surprisingly good except in the actually gangrenous areas. The force needed to produce an excellent arterial injection is decidedly less than that required for an imperfect venous injection.

3. The return flow is normal if the artery is injected. If the vein is injected there is no return flow through the artery, but some of the fluid may be promptly short-circuited through immediately adjacent tributaries.

Although the above experiments are more or less decisive, I determined to make an accurate study of the cases which have been subjected to arteriovenous anastomosis up to date to see if some further conclusions might not be drawn from a study of the clinical material.

The result of this study will be seen in the accompanying table. The cases of Goyanes and Tuffier have been omitted because I believe they are not pertinent to the discussion. Several incorrect and duplicate quotations have also been eliminated.

A careful survey of this table must impress even the most enthusiastic adherents of the operation that very brilliant success cannot be claimed for it, at least numerically. I cannot agree with Wieting and Danis that one ought to judge the value of arteriovenous anastomosis only by its successes. An analysis of both the failures and successes will give a much more just valuation.

In a total of 136 published arteriovenous anastomoses or attempts thereat there have been 30 deaths immediately or shortly follow-

[1] There has just appeared a paper by Horsley and Whitehead, J. Am. M. Ass., 1915, lxiv, 873, in which the authors report on the results of a series of animal experiments to determine the utility of arteriovenous anastomosis. These experiments are practically the same as the ones which I had contemplated performing to answer the argument that the constant pounding of the heart would eventually overcome the obstruction offered by the valves and which I hinted at in the body of my paper. The essential feature of these experiments is the creation of an arteriovenous anastomosis and an arterial injection above the anastomosis at some later date. A gelatin-cinnabar mass was used for the injection and then a radiograph was taken. The results of Horsley and Whitehead are quite what I anticipated they would be; i.e., the blood returns by the nearest anastomotic route and there is no circulation in the periphery of the limb. In every respect their conclusions coincide with mine.

ing the operation and 11 deaths following the operation after an amputation—a total of 41, or a mortality of more than 30 per cent. Death was usually due to shock, pneumonia, or sepsis from a rapidly progressive gangrene.

This high mortality is not astonishing when one considers that the degenerated hearts of many of these patients could poorly stand the strain of the changed circulatory conditions and that serious wound complications were to be expected in these debilitated individuals. Furthermore, the patient's life might easily be placed in jeopardy because of the delay in performing an amputation which might be life-saving. Of the cases that did not die 45 have required amputation. The fact that an amputation below the knee has sufficed after an arteriovenous anastomosis is no proof of the efficacy of the operation, for, as is well-known, such a low amputation is often successful even in diabetic cases. Almost every case that was examined pathologically showed a thrombotic occlusion at the anastomosis or in the vessels below it. In 12 cases it was necessary to abandon the operation on account of too extreme occlusion of the lumen or too extensive disease of the wall of the artery, or because of thrombosis of the vein. In other words, in more than 72 per cent of the cases the operation or the attempt was practically a total failure, although it cannot be denied that some of the cases were evidently hopeless from the beginning and that in others occasionally demarcation or temporary improvement seemed to occur.

In 8 cases the result was inconclusive. In one of these (Case 3 of Coenen)—a profunda femoris—internal saphenous anastomosis was tried as an experiment for varicose ulcer, but, although the anastomosis functionated, on account of increasing œdema the anastomosis was later excised and the vessels ligated. Case 7 of Tilton and Case 8 of Grant are too recent to warrant any conclusions. In 6 cases success was claimed in operations on the upper extremity; in 2 of these (Case 1 of Doberauer and Case 2 of Heymann) the results were not conclusive, but, even if they were, I must agree with Freeman in seriously questioning the successes especially in the upper extremity inasmuch as spontaneous recovery from beginning gangrene of the fingers is of common occurrence. One must admit, however, that the risk of the operation is decidedly less in the upper extremity.

There remain 24 so-called successful arteriovenous anastomoses in the lower extremity, in some of which the patient merely survived the operation and the limb only escaped amputation. Case 2 of Ballance died four months after operation from a gangrene of the colon, and must be discarded. Case 9 of Davies developed a hemiplegia two months after operation, which fact certainly militates against our regarding this case as a successful one. Goodman, in a personal communication, has informed me that an amputation has since been performed on one of his successful cases. Case 15 of Perimoff was merely a lateral implantation of the saphenous vein into the posterior tibial artery and can scarcely be regarded as a typical example of the operation under consideration. Cases 17 and 18 of Thomson were the both extremities of the same individual, who later also developed a hemiplegia, for which, at the patient's request, a common carotid-internal-jugular anastomosis, as suggested by Jaboulay, was also performed! These cases are very casually mentioned in a discussion. Cases 19 of Porta and 20 of D'Oria are likewise very indefinitely referred to. This leaves 16 successes, or about 11 per cent. Of these, 11 are reported by four men; namely, Wieting, the main advocate and staunchest defender of the operation, Bernheim, Goodman, and Lilienthal.

I am convinced that this analysis displays the operation in a much more favorable light than the actual reality warrants. It may be safely assumed that practically all the successes have attained publicity, but it is quite certain that many failures have been suppressed. Rumors of some of these have reached my ears. Then some of the reports of successful results may have been a trifle premature. That this is possible has recently been pointed out by Buerger who was

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Injection of anterior and posterior tibial veins with 10 per cent solution of collargol. Gravity method, 3 m. for 18 hours. Amputation for diabetic gangrene.

Fig. 2. Injection of popliteal vein with 20 per cent neutral lead acetate solution. Gravity method, 2.8 m. for 44 hours. Limb amputated for diabetic gangrene.

Fig. 3. Forcible injection of femoral vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for recurrent sarcoma of femur with spontaneous fracture.

compelled to amputate the limb after an arteriovenous anastomosis reported as successful by another surgeon. It may be of interest to note that he found not only a complete obliteration but true bone formation at the site of the anastomosis!

Granting the correctness of the observations as to improvement (i.e., mainly cessation of pain, arrest of the threatened gangrene, apparent improvement in the sensation, color, and temperature of the affected extremity, and restoration of the function of the limb) in the so-called successful cases, must we explain this improvement on the basis of a functionating arteriovenous anastomosis? It is common knowledge that just in these cases many methods give similar results. Conservative treatment in general (Stetten), rest in bed, moist dressings, warm saline baths, active hyperæmia or thermotherapy (Bier, Röpke), passive hyperæmia (Frommer), hypodermoclysis of Ringer's solution (Koga), alternating hot and cold baths (Borchardt), diathermia (Kowarschik), postural treatment (Buerger), all tend to improve and, to a certain extent, cure these cases. Furthermore, spontaneous remissions, often of years' duration, are not at all uncommon, particularly in the thrombo-angiitis obliterans type. Incidentally, the cases of so-called successful arteriovenous anastomoses, almost without exception, belong to this category. It is extremely likely that some of these factors have played a rôle in many of the reported successes of the Wieting operation. At any rate, it is quite certain that a similar series of cases treated by any of these methods would show as good a percentage of successful results, and in all probability a better. There is further no doubt that the mortality would be decidedly lower. In a previous communication I reported a series of 17 unselected cases of

Fig. 4.

Fig. 5.

Fig. 6 (above). Fig. 7 (below).

Legends on opposite page.

diabetic gangrene treated by a routine conservative method. Only 5 of these patients died and 9 were cured without amputation.

In addition to the above, von Oppel and others (Hauke, Coenen, Hesse, Moszkowicz, Lidski, Sokoloff, Fedorowitsch, Babitzki, Pikin, Lilienthal, Van Beuren) have shown that a ligation of the femoral vein below the saphenous opening, by impeding the venous return, increases the pressure in the capillary system and in the arterial collaterals. This theoretical conception has been put to a practical test in quite a number of cases and the results are vastly more satisfactory than those of arteriovenous anastomosis. Moreover, as far as I can discover, there have been no direct fatalities. Lilienthal has even had a successful result after simple multiple ligation of superficial varicose veins. If these observations on ligation of the femoral vein are correct, it is very probable that one of the main factors of success in arteriovenous anastomosis is merely the impeded venous return. Strong presumptive evidence to this effect is found in a number of cases in which arteriovenous anastomosis was performed where, in spite of the fact that the anastomosis obviously did not functionate on account of thrombosis (negative Cases 2 of Tuffier and 4 and 5 of Bernheim), there was a decided amelioration in the symptoms. If these conclusions are warranted, venous ligation is a much more rational procedure, because it is not only a much simpler and safer operation, but the already imperfect arterial circulation is not further interfered with.

It should also be emphasized that in all the successful cases a laterolateral anastomosis was performed, or else if the artery was divided, this was done below the point at which the profunda is given off. In other words, the arterial circulation was not disturbed at all or else an ample collateral circulation was always possible. This fact rather justifies the suspicion that the extremity was saved not because of the operation but rather in spite of it. At any rate, it certainly seems that the operation is likely to do more harm than good and that the slim chances of recovery, that these cases have, are entirely destroyed unless the arterial circulation is not too extensively disturbed.

I do not wish to be construed as denying the possibility of establishing a permanent arteriovenous anastomosis. From clinical, pathological, and experimental sources ample evidence is found that this can be done. The dilatation of the veins or the occasional persistent venous pulsation, thrill, or bruit (Bernheim, Goodman, Vaughan, Neal) is convincing proof that the anastomosis is functionating. Arterial bleeding through the veins during amputation (Hubbard, Wieting), even with spurting (Bernheim), is further presumptive evidence in favor of this. In a few of the failures that came to pathological examination, a perfectly patent anastomosis without thrombosis was found, even some time after the operation (Jaboulay, Goodman). From an experimental standpoint, the matter is settled beyond all dispute. Since Gluck, in 1898, first performed a successful carotid-jugular anastomosis, many have succeeded in establishing permanent arteriovenous communications in various vessels. Among others who have done this may be mentioned Carrel with Morel and Guthrie following his failure with Bérard, Watts, Tuffier, Frouin, Hadda, Danis (carotid-jugular and femoral), Leriche (splenic), Franz, Bernheim, Yamanoüchi, and Jianu and Meller (femoral). Direct observation on the flow of blood immediately or a short time after operation (Cottard and Villandre)

Fig. 4. Forcible injection of popliteal vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene.

Fig. 5. Injection of popliteal artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene. Same extremity as Fig. 4.

Fig. 6. Very forcible injection of posterior tibial vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene.

Fig. 7. Injection of popliteal artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene. Same extremity as Fig. 6.

Fig. 9. Fig. 8 (above). Fig. 10 (below). Fig. 11.

Legends on opposite page.

Fig. 12. Forcible injection of posterior tibial vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for senile gangrene.

Fig. 13. Fig. 14.

Fig. 13. Forcible injection of femoral vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb re-amputated for senile gangrene.

Fig. 14. Injection of femoral artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb re-amputated for senile gangrene. Same extremity as Fig. 13.

has no great scientific significance. Finally the occurrence of congenital, pathological, or traumatic arteriovenous aneurisms is proof conclusive that a fistulous communication between artery and vein is possible.

My contention is that even granting the possibility of establishing a permanent anastomosis between artery and vein, which, as we have seen from the many failures, is a difficult proposition for technical reasons, this anastomosis is of no value in bringing more blood to the periphery. That is proved practically by the failure of the operation to save the limb in spite of an actually patent anastomosis (Jaboulay, Goodman), or of arterial bleeding through the veins at amputation (Hubbard, Wieting, Bernheim). Rather do I believe that a successful anastomosis may, in the end, be more harmful than a thrombosis at the site of operation which might act as von Oppel's ligation. If one succeeds with the anastomosis one really produces an arteriovenous aneurism and perhaps all the evils that accompany this distressing malady, i.e., the varicosities, œdema, ulceration, and eventual elephantiasis. Aside from any other consideration, is there not just an element of surgical hysteria or, at least, of lack of judgment in the desire to produce, for therapeutic purposes, a lesion which, when found as a pathological entity, invariably demands operative intervention for its relief and frequently urgent intervention at that?

Parenthetically, it might be observed that several experimenters, among others Carrel and Guthrie, Watts, Unger, and Bethmann, have noted eventual sclerotic changes in the wall of the vein with a tendency toward obliteration after successful arteriovenous anastomosis, due probably to the effect of

Fig. 8. Forcible injection of popliteal vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene.

Fig. 9. Injection of popliteal artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for diabetic gangrene. Same extremity as Fig. 8.

Fig. 10. Forcible injection of popliteal vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for presenile gangrene.

Fig. 11. Injection of popliteal artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for presenile gangrene. Same extremity as Fig. 10.

Fig. 15 (above). Fig. 16 (below). Fig. 17 (above). Fig. 18 (below).
Legends on opposite page.

the abnormal arterial pressure upon the vein. Although this has been disputed by Levin and Larkin, the likelihood certainly seems to exist. If this is true, another nail has been put into the coffin of arteriovenous anastomosis.

I cannot refrain, at this point, from entering a protest against the adoption of the term "reversal of the circulation" so frequently used even in the latest publications on the subject. To be sure, as authoritative an investigator as Carrel claims that this is experimentally possible; i.e., that arterial blood can reach the periphery through the vein and return through the artery. Incidentally, Carrel claims that this is only possible in a terminoterminal anastomosis and cannot occur in a laterolateral operation, which, today, according to Bernheim and Wieting should be the operation of choice. Without entering into the merits of his contentions, which, by the way, are based on one experiment of five hours' observation and which are opposed by the vast majority of even those experimenters who have succeeded in establishing permanent anastomoses, and admitting the possibility in the dog, there is certainly no evidence that this can occur in the human. Let us grant that the valves, or at least some of them, can be forced. Let us also admit that possible variations in the veins may permit a retrograde flow, or as Gallois and Pinatelle and Wieting suggest, that the valves are incompetent in certain cases due to old age or disease, although the authority for this latter suggestion (Klotz) studied only the saphenous vein which presents an entirely different problem. At any rate, in my experiments, the majority of which were made on extremities of elderly individuals with vascular disease, there is no special evidence that the valves in the deeper veins are inefficient. Even conceding, however, that for one or the other reason a backward flow through the veins is possible, there is nevertheless no evidence of a reversed capillary circulation. As Ricard and Delbet and others maintain, the best that can be said for the circulatory conditions is that the blood might reach the periphery and then return through collateral venous channels so that the tissues are bathed in an intermittent, wavelike flow (Jeger). The blood will surely return from the periphery through the first venous tributary or its numerous anastomoses, even if the valves above have been forced. It is surely easier for the blood to return this way than to force further valves or to overcome the resistance offered by the capillaries. This fact was most beautifully demonstrated in my Experiments Nos. 12 and 13 both during the performance of the experiment and by the subsequent radiographs (Figs. 12 and 13). Finally, even admitting that the blood may reach the capillary network, it could not by any possible chance return through the diseased artery. Even the enthusiastic Wieting admits the absurdity of this contention. If the vessel is so obstructed that the circulation is insufficient with normal or even high arterial pressure, a return flow through this same vessel under low venous pressure is obviously out of the question. Merely for the sake of completely clinching the argument, it might be added that in the majority of even the successful cases the artery was actually ligated below the anastomosis.

It has been claimed by Wieting that most of the failures have been due to improperly placed indications. Without going into detail, Wieting advises operation only in cases where the general condition of the patient, the extent and progress of the circulatory disturbance, and the state of the vessels themselves are all relatively favorable. To

Fig. 15. Forcible injection of axillary vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for recurrent sarcoma of humerus and shoulder.

Fig. 16. Injection of axillary artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for recurrent sarcoma of humerus and shoulder. Same extremity as Fig. 15.

Fig. 17. Forcible injection of popliteal vein with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for gangrene due to thrombo-angiitis obliterans.

Fig. 18. Injection of popliteal artery with 50 per cent emulsion of red oxide of lead in paraffin oil. Hand syringe method. Limb amputated for gangrene due to thrombo-angiitis obliterans. Same extremity as Fig. 17.

my mind, that type of case would be just suitable for non-operative treatment. At any rate, a questionable and somewhat dangerous surgical procedure would certainly not be warranted. In diabetes, where all complicated operations are frankly contra-indicated, arteriovenous anastomosis should certainly not be done. In senile gangrene, the calcareous degeneration of the artery is usually so marked that suture of the rigid, atheromatous vessel is out of the question; yet if the disease of the artery is not advanced, the operation is surely not indicated. In cases of thrombo-angiitis obliterans, as Buerger in his classical studies of the disease has shown, the veins are very frequently as diseased and obliterated as the arteries; this applies not only to the deep, but also to the superficial, veins. Admitting the claims of the adherents of the operation, that a peripheral venous flow is possible and that the return flow takes place through the anastomoses of the collaterals with the superficial veins, the operation must needs be unsuccessful if either the deep or superficial veins are occluded. From the above it would seem that the indications for the operation, admitting its possible utility, are decidedly restricted.

It might be pertinent to the question under discussion to call attention here to the fact that the occurrence of gangrene, although usually, is not always, due to mere arterial obstruction and impoverished circulation. In my previous paper on the treatment of diabetic gangrene I reported several cases of extensive gangrene of the lower extremity in which the posterior tibial or dorsalis pedis pulse or both were distinctly palpable. In one instance severe arterial hæmorrhage occurred through the sloughing wound of the foot. Buerger has noted similar phenomena in cases of thrombo-angiitis obliterans. In treating such cases nothing could be more illogical than the performance of an arteriovenous anastomosis.

From the preceding I think it must be conceded that the utility of arteriovenous anastomosis as a therapeutic measure is open to grave question. I believe that I have effectually shown:—

1. That the arterial circulation to the periphery, even in very advanced arterial disease, is in every respect better and easier than the retrograde venous circulation, mainly because of the obstruction offered by the valves and the short-circuiting of the blood through anastomoses of neighboring venous collaterals.

2. That the operation is dangerous and the results have been most unsatisfactory except in a very small percentage of cases.

3. That the few so-called successful results have probably been obtained more in spite of than because of the operation, inasmuch as various factors play a rôle in the improvement of these cases, as improvement has been recorded after definite closure of the anastomosis, and as failure has occurred with perfect patency of the arteriovenous fistula.

4. That even if the anastomosis functionates, which it rarely does, there is no possibility of circulatory improvement, but rather quite the reverse.

5. That the term "reversal of the circulation," at least as far as clinical cases are concerned, is absurd.

6. That even if the usefulness of the operation were proved beyond question, the possible indications would be restricted to an unappreciable minimum.

I, therefore, feel that the scepticism of Lejars, Lenormant, and Wettstein is a trifle too mild. Even Coenen is not quite emphatic enough, to my mind. I rather agree with Guthrie, who, although having once claimed to have shown with Carrel the possibility of reversal of the circulation in the limb of a dog, deplores the fact that arteriovenous anastomosis should have been applied to the human being for circulatory disturbances of the lower extremity and prophesies its failure; for I believe that it is very questionable if the operation is ever justified. I do not think that I am going too far in advising that this procedure be entirely eliminated from our surgical repertoire.

In conclusion, I desire to acknowledge my indebtedness to all the gentlemen of the surgical staff of the German Hospital who so kindly placed their material at my disposal

and to Dr. William H. Stewart for his invaluable assistance in the radiographic work.

[After the completion of this paper an article by Narath appeared in which he recommends arteriovenous anastomosis between the hepatic artery and portal vein to prevent liver necrosis in cases where ligation or excision of an hepatic aneurism should be necessary. His recommendation seems well supported by experimental evidence. Should his contentions prove to be justified, no deductions in favor of the Wieting operation could be made therefrom. Such an hepatic-portal anastomosis is an entirely different affair. Here the flow of blood is in the normal anatomical direction instead of against the current as in the femoral arteriovenous anastomosis.]

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LOCAL INFECTION DUE TO INTRAVASCULAR DISSEMINATION OF BACTERIA; THE ASSOCIATION OF DIPHTHEROID BACILLI WITH VARIOUS DISEASE CONDITIONS[1]

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IN this paper I wish to record certain results which indicate that the embolic origin of infection is far more common than has been believed in the past, that a certain type of thrombosis is apparently due to a particular diplococcus and results of cultures from the blood and other tissues together with illustrative cases which indicate that diphtheroid bacilli may be the cause of certain unusual forms of infection.

The hæmatogenous origin of infection in regions which do not normally harbor bacteria, such as the endocardium, pericardium, joints, and bone, is accepted. The mode of origin of appendicitis, ulcer of the stomach, cholecystitis, and other infections in regions normally harboring bacteria is not so clear and is usually considered a local invasion even where the clinical facts suggest an hæmatogenous origin. Until recently this view was held because of the meager experimental evidence that they may be produced by intravenous injection. In some experiments which I have performed recently, the importance of the blood stream as a carrier of infection is very evident and the elective localization of streptococci from appendicitis, ulcer of the stomach, cholecystitis, and rheumatic fever in the respective organs occurs commonly with the strains soon after isolation, while later they lose this affinity entirely.

The tendency of the streptococci from rheumatic arthritis to infect over a wide range is shown in the animals just as is observed in man. The details of the results of these experiments are reserved for other papers.

By the application of improved methods it is certain that the blood stream is invaded far more frequently than has been known in the past. The mechanism of the entry of bacteria into the blood stream is not entirely clear. The importance of large thrombi in this connection, however, is evident. The common occurrence of typical septic temperature in cases of sinus thrombosis, for example, where the bacteria grow in the thrombus and intermittently invade the blood, suggests that a similar mechanism causes puerperal sepsis or the septic fever which sometimes follows appendectomy, for example, where there is no evidence of gross thrombosis or abscess formation. In some instances there seems to be an adaptation which allows the microörganism to enter and grow in the circulation where little or no local disturbance exists.

The important rôle of infection as the cause of thrombosis is very apparent from McClean's experiments and is always very evident clinically and anatomically in those cases where there is softening of the thrombus and suppuration in the region where emboli lodge. Here, as in the experiments of McClean, bacteria of a relatively high grade of virulence are responsible. The cause of the formation of post-operative thrombi following herniotomy or appendectomy, for example, where they form in other regions than the field of operation, producing little fever or other symptoms but giving rise commonly to fatal pulmonary embolism, is not so clear. I have had opportunity to make cultures from the blood or thrombus, or both, in a number of these cases. A pure culture of a Gram positive, relatively avirulent, short chained, non-encapsulated, green producing diplococcus, has been isolated from one case of primary portal thrombosis, from four cases of fatal post-operative pulmonary embolism following appendectomy, herniotomy, and hysterectomy, from the blood in two cases of thrombosis following labor (both of which recovered), and from the blood in one case of quite generalized venous thrombosis which began in the iliac veins in a case of sarcoma of the pelvis with marked pressure. The same

[1] Presented at a joint meeting of the Chicago Surgical and Pathological Societies, January 8, 1915. See discussion, p. 496.

organism was isolated in almost pure culture from the thrombus in the pulmonary artery, which caused the death of a patient following a post-operative peritonitis. The cultures from the peritoneal exudate showed mostly hæmolytic streptococci but also a few of the above green producing diplococci.

Intravenous injection of the strain from the case of portal thrombosis produced thrombosis in the portal vein in rabbits. It seems, therefore, that cases of thrombosis in which there is little or no fever, which occur commonly a week or ten days after anæsthesia or operation, the time when the blood coagulates rapidly, as shown by Hamburger and Ewing[1] are associated commonly with a particular organism. The fact that the thrombus forms often in regions other than the place of trauma and in cases where no apparent infection exists emphasizes the importance of searching for and removing if possible foci of infection which are known to harbor similar organisms, such as the tonsils and pus-pockets about the teeth, a point not yet sufficiently recognized. The etiologic rôle of the organism can scarcely be questioned, but apparently it can produce thrombosis only when the coagulability of the blood is high and when a certain amount of stasis exists.

The exact relation of diphtheroid-like bacilli to disease in man is not well understood largely because when injected into animals they frequently show little or no pathogenic powers. That they produce disease, however, in some instances is certain, because Ghon and others have demonstrated them in the vegetations of certain cases of endocarditis, and I have shown their presence in the blood and the nodes of erythema nodosum and have produced similar lesions in animals by intravenous injection. From the following cases the idea that a similar variation in the pathogenic powers of these organisms exists as is found in the streptococcus group receives some support.

Blood cultures made by the usual technique rarely yield these organisms. By means of a method,[2] however, in which due regard is paid to the question of oxygen pressure, I have succeeded in isolating this type of organism in pure culture from the blood during life in two cases of erythema nodosum, two cases of exophthalmic goiter, in four cases of Hodgkin's disease during the febrile period in two cases of endocarditis, in one case of rheumatism, and in two peculiar fatal cases of purpura hæmorrhagica. The two cases of purpura which occurred in the practice of Drs. Webster and Wells had a similar history. Pericarditis was present in both, marked hæmorrhages of the skin and mucous membrane occurred, the fever was never high, leucocytosis was slight or absent, but there was marked mental and cardiac disturbance from the beginning. Both had some disturbance of the teeth previously and in one the same organism as was found in the blood was isolated from a suppurating sinus at the root of an abscessed tooth.

The results in the following case are of interest:

A girl, 14 years, a case of Dr. Miller's, had a bronchopneumonia following a severe cold, from which she apparently recovered, but April 14, 1914, five days previous to making the blood culture, there was discovered a mitral murmur associated with return of some fever. The day after making the blood culture she developed arthritis but ultimately made a complete recovery. The blood culture showed a pure growth of a diphtheroid-like bacillus which produced, when injected into a rabbit, marked hæmorrhages in the lungs and bronchopneumonia, a multiple non-suppurative arthritis, endocarditis, pericarditis, myocarditis, and a localized infection in the muscular coat of the stomach.

A diphtheroid bacillus was found in the abscess of a tooth, in the blood, in the erythematous node of the skin of the forearm during life, and in the vegetation and acute ulcers of the stomach in a case of acute fatal arthritis following extraction of abscessed teeth in a patient of Dr. Billings. The abscesses were the source of infection of the chronic arthritis which was present for some years previously.

The findings in a patient of Dr. Whitaker are of interest:

For the past two years the patient, a man of 27 years, has had occasional disturbances of stomach accompanied by pain. Six months ago he had an attack of dull aching pain in the epigastric region which was continuous and accompanied by nausea and constipation and relieved by sitting down or lying on his back and, temporarily, by taking food.

[1] J. Am. M. Ass., 1908, li, 572.
[2] Rosenow. J. Am. M. Ass. 1914, lx.ii 903.

This attack lasted seven days and then disappeared. An exactly similar attack occurred ten days before he was given, in the late forenoon of October 26, osteopathic manipulations of the abdomen. Three hours later he was seized with a violent pain in the epigastrium which doubled him up, the abdomen became tense, the temperature was subnormal, the pulse rapid and irregular, there was marked pallor. A diagnosis of perforated duodenal ulcer was verified the same night at operation by Dr. Whitaker. A large accumulation of pus had already taken place. The small perforation in the indurated ulcer (2 x 1.5 cm.) on the anterior surface of the first portion of the duodenum was closed and drainage established. Ten days later the patient developed an annoying dysentery, but this disappeared in a week. The symptoms referable to the ulcer gradually subsided, but he developed a typical septic fever accompanied by marked and exhausting sweats, weakness, and emaciation, which gradually grew worse. After some weeks of the septic fever the patient developed severe pain in the middle portion of the femur and circumscribed red tender symmetrically placed nodules along the course of the subcutaneous veins in the forearm.

On December 18 Dr. McArthur saw the patient and suggested having a blood culture made to determine the cause of the sepsis since examination of the abdomen was quite negative. The pus which I expressed from the tonsil yielded a predominating and large number of diphtheria-like bacilli, together with some streptococci, while the blood yielded a pure growth of a similar bacillus. A vaccine prepared from the diphtheroid bacillus obtained from both regions was followed by a disappearance of the septic fever and the pain in the femur, and the nodules on the forearm disappeared, the appetite became marked, and he made an uninterrupted recovery.

From a consideration of these findings the idea that a similar variation in the pathogenic powers of the diphtheroid group of organisms exists as in the streptococcus group receives some support. However, the possibility that the diphtheroid bacilli are mere secondary invaders must be considered seriously until definite experimental proof has been brought forward that they are actually the cause of each individual disease.

A CASE OF CHORIO-EPITHELIOMA MALIGNUM COMPLICATING A TWO-MONTHS' PREGNANCY AND A DEGENERATED UTERINE FIBROMA [1]

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WHETHER chorio-epithelioma malignum is a rare disease or more common than the literature would indicate, as many writers state, I will not attempt to discuss here at length. But we know that less than 500 cases are thus far recorded. Judging from its onset, which is often sudden with death ensuing rapidly, and because of the failure of many to study carefully curettings and autopsy specimens and because of the lack of suspicion as to the nature of the disease on the part of the attendant, noted so frequently in the recorded cases, I believe many unrecorded cases have occurred. In none have I found complications reported which were similar to those in the case here recited nor in such an early pregnancy; none with so little symptomatology. It has been found complicating fibroids but with severe symptoms, notably hæmorrhage. In my case no hæmorrhage occurred. Nor has it been found complicating an early pregnancy without symptoms as in the case I here report.

It will be noted that my patient had been pregnant last thirteen years before and had aborted without incident at six weeks and that no menstrual or pelvic symptoms followed until after pregnancy began in July last, and even then nothing indicated an abnormality other than the fibroid complicating pregnancy.

It may be said, then, that I report this case, *first*, because of its early discovery; *second*, its complicating an early (six weeks) normal pregnancy; *third*, it also complicates a degenerated uterine fibroid; *fourth*, it has no symptomatology; *fifth*, it was removed

[1] Read before the Southern Surgical and Gynecological Association, Ashville, North Carolina, December, 17, 1914.

early and perhaps entirely; and *sixth*, that while the growth had passed from the villi into the uterine muscle, microscopical study of the uterus and absence of symptoms fail to indicate the existence of metastasis.

The history of the case is as follows:

Mrs. F. K., white, 41 years, resident of Wilmington, Delaware, consulted me September 25, 1914, for the presence of an abdominal tumor that had recently been the seat of severe pain. She had been married eighteen years and had given birth to two children, now aged fifteen and fourteen years, respectively. Thirteen years ago her only other pregnancy terminated in an abortion at about the sixth week. Her menstruation had always been regular until May 22, when it was delayed a few days but continued the usual three days. In June it was a little more delayed but lasted the usual three days. July 23 to 25, the last period, was six days late. Her periods were always painless and moderate in amount.

No vesical symptoms, except frequent urination had supervened. She had not suffered from constipation, but about August 25 she had vomiting and purging for two days, followed by constipation and purging alternately to date. The vomiting had suggested "morning sickness" though it frequently occurred in the evening. The vomiting and amenorrhœa had caused a suspicion of pregnancy but the pain in the tumor had alarmed her. A surgeon in Wilmington had diagnosed a tumor and possible pregnancy and advised removal of tumor.

Examination. The patient is a well-nourished, plump woman. No breast changes of pregnancy are detected. In the abdomen a mass is felt extending from the pubes to umbilicus and from the midline to the extreme left side of the cervix. It is hard but tender and somewhat movable. The cervix is softened and another mass, movable and dense, much smaller than the one previously described, is found to the right. It is found firmly attached to the cervix. It is thought to be the uterine body, pregnant, and displaced upward and to the right by the left tumor or a pregnant right horn of a bicornate uterus and a degenerating fibroid in the left one. Neither appendage is recognized. Operation was recommended and performed next day. The body of the uterus and a necrobiotic uterine fibroid (the left mass) and the vermiform appendix were removed. No adhesions were encountered and the normal appendages were not disturbed. The specimen was opened, the tumor showing the changes mentioned and the uterine body containing a fœtus of about six weeks' development. The uterine cavity was not laid open sufficiently to expose more than the fœtal sac and its contained fœtus. The uterine body was but a projection from the tumor, and myomectomy was discarded. After the operation was finished a hospital interne split the uterine body widely and discovered the chorionic changes before sending the specimen to the laboratory. There, Dr. J. B. Briggs, professor of pathology, after many sections, reported it as chorio-epithelioma malignum that was present in the removed tissues only in the chorion and attached portion of the uterine wall.

October 14, the cervix was removed *per vaginam* and Dr. Briggs reported it free of the disease. The appendages were not removed. The patient was examined December 14, 1914, and bore no evidence of the presence of the chorio-epithelioma.

Report of Dr. Briggs. Tissue received September 26, 1914 and October 14, 1914. Clinical diagnosis, chorio-epithelioma malignum. Remarks: Many sections of the fundus, cornua, body and neck of uterus were made. No invasion of syncitioma was found in these regions. It was in one section only, which was made between what appeared, owing to the distortion due to the fibroma, to be the apex of the fundus and the left cornu that any trace of invasion of maternal tissue was discovered. In this region alone definite syncitiomal growth showing particularly the characteristics of Langhans' layer, intruded upon the maternal tissue. No peritoneal invasion was discoverable nor were any metastases found in neighboring organs.

DEFINITION OF CHORIO-EPITHELIOMA MALIGNUM

Chorio-epithelioma malignum is a form of malignant neoplasm that occurs in both sexes, though much more frequent in females than in males. It usually arises from pregnancy, often from leaving behind fragments of chorionic tissue, normal or abnormal, which have been retained from a pregnancy which either went to full term or terminated in miscarriage or abortion and particularly if degeneration of the placenta or chorion into a hydatid mole has occurred. It may occur in women before (Pick's case, 16) or long after (Devitzky's case 6,) the procreative zone of the life of woman. It may be found in men in organs most subject to teratomatous formation (Schlagenhaufer's 2 cases, 20, and Emanuel's cases, 8), as the testicle and mediastinum; and that it may also be found in the testicle independent of teratomata (von Hansemann, 11, and Emanuel). In man it is nearly always of teratomatous origin though cases have been carefully studied and reported as being entirely free of teratoma.

HISTORY

To quote from Caturani's (2) valuable monograph on chorio-epithelioma and other

papers on the subject, Netzel in 1872, Mayer in 1876, Chiari in 1878, Hofmeyer in 1885, and Mayer in 1888 observed and reported a disease similar to chorio-epithelioma, but its nature was not clearly understood until Sänger (17) in his paper before the Leipzig Obstetrical Society, July 16, 1888, described a tumor differing absolutely from any known tumor and emphasized its peculiar relation to pregnancy. He stated that the microscopic examination showed it to be a very hæmorrhagic tumor made up of cells similar to those found in the decidua and was a malignant metastasizing deciduoma.

He described the case more fully before the German Gynecological Society in 1892 (18). In 1893 (19) he made it the nucleus of an exhaustive monograph published in the *Archiv für Gynäkologie*. In 1889 Pfeiffer (15), a pupil of Chiari (3), ignorant of the work of Sänger, described a similar case, calling it deciduoma malignum, and stated that Chiari (3) now regarded the three cases he had reported two years before as carcinoma of the uterus following the puerperium as identical with the one Pfeiffer was reporting. Gottschalk (10) thought it of fœtal origin and the tumor sarcoma of chorionic villi.

J. Whitridge Williams (23) called attention to the emphatic presence of chorionic structures in his specimen thus differing from Sänger's case. Appelstedt and Aschoff (1), in 1896, still further emphasized the fact that chorionic tissue was the essential feature of such tumors and two years later Marchand (14) clearly demonstrated that all such tumors were from the layer of Langhans and contained syncitial tissue, and therefore were chorionic and not decidual in origin. He called the new-growth "chorio-epithelioma," a name that has been universally adopted. In some instances the new-growth has been found only in the chorion and therefore is not considered malignant. This has led many to add to the name the qualifying word "malignum," which, is really superfluous.

STRUCTURAL CHARACTERISTICS OF CHORIO-EPITHELIOMA

The tumor is usually dark gray or nearly black in color and if attached to a surface, such as the uterine or vaginal wall, may be rounded much like a polyp. In the vaginal wall the masses of this form of tumor are distinctly nodular.

In metastases in the lung, liver, kidney, spinal cord, or ovary, it may assume various shapes though usually it is nodular. At all events it is soft and has the appearance of having been subjected to some form of traumatism and blood-clot about is always noted. It essentially contains quite well arranged cells from the syncitium and Langhans' layer. In many, villi are distinctly seen though to a less extent in the metastases and, I believe, never in the male.

The primary tumor if in the uterus may attain such size as to be mistaken for a uterus pregnant seven months but is more apt to be small. In fact, the uterine condition, primary focus, may be entirely overshadowed by vaginal metastases of much greater size.

METASTASIS

By no means is there a thorough agreement among pathologists regarding the danger and time of metastasis. Many believe that fragments of the villi are carried through the blood-channels to other parts even in normal conditions and in many cases the first and only evidence of the disease is in metastases found principally in the lungs. In such the primary focus may not be easily located if various organs are involved. Certainly if the uterus is at the time free of the disease it cannot be regarded as the primary focus. Moreover, in a few cases, fatal in result, the growth has been recognized in the chorion with metastases in the vagina or the lungs and abdominal viscera, and the uterus not invaded.

While the new-growth usually begins in the uterine gestation contents and invades the uterine wall and later metastasizes we have just referred to the evident passage through the blood-channels of fragmentary villi that find lodgement and, perhaps after a long period of quiescence, become malignant.

VARIETIES OF CHORIO-EPITHELIOMA

Besides the variety, the identity of which was definitely established by Marchand in

1898 and proclaimed to be absolutely a result of pregnancy, two cases were reported by Schlagenhaufer, in 1902, of malignant tumors of the testicle in which he had found chorio-epitheliomatous elements; viz., syncitial masses and groups of Langhans' cells. In 1904, Emanuel collated fourteen such cases and described one of his. The close resemblance of the chorio-epithelioma was indicated by the presence in some of them of cystic bodies, which from both the microscopical and naked eye appearance resemble the hydatid mole vesicles. Schlagenhaufer believed, and his opinion is generally accepted, that the peculiar fœtal ectodermic tissues found in these testicular tumors were derivatives of embryonic relics belonging to the stage of development in which chorionic tissue is so abundantly produced. Similar tumors have since been found in various parts of the body in which teratomata abound. But, further, another variety was found in man—a pure chorio-epithelioma having no usual characteristics of dermoids or teratoma, but which consisted solely of blood-clots, fibrin, and the essential plasmodial and cellular elements. It was not to be distinguished from the chorio-epithelioma found in the uterus and vagina. Von Hansemann's case reported in 1904 was of a tumor of the testicle with metastasis to the abdominal viscera and was described as follows: "All the growth consisted of fibrin and blood-clot with much leucocytic infiltration; running through the blood-clots are grayish strands of tissue which consist of Langhans' cells and syncitium." Emanuel recorded a similar case. Eden (7) considers them also of teratomic origin. Eden also believes that chorio-epithelioma of teratomic origin can also occur in the female in whom pregnancy cannot possibly enter into the etiology. He quotes two cases to substantiate this view. The first was that of Pick, which was that of a girl of eight and one-half years in which menstruation had never occurred and from whom was removed an ovarian tumor consisting mainly of typical teratomatous structures but which in parts showed typical chorio-epitheliomatous elements, some of the sections exhibited being indistinguishable from Marchand's tumor. He states that "this case of Pick obviously reproduces all the essential features of the testicular growth recorded by Schlagenhaufer and others and may, nay, must, be explained upon the same hypothesis."

Although the age of Pick's patient does not positively preclude pregnancy the general teratomatous characters of the tumor removes all objections to be raised on that score. Devitzky has a very remarkable case that also is used quite reasonably to support this theory.

It was of a woman 75 years of age who was admitted to the gynecological clinic of the University of Moscow (Professor Michael Nikiforoff) October 1, 1903. "She had been having irregular uterine hæmorrhage for two years; dyspnœa, cough, bloody expectoration and painful micturition of recent onset. The menses ended at the age of 55 years and had always been regular. She presented the anatomical signs of virginity and firmly denied she had ever been pregnant." While in the clinic micturition was painful and frequent and the urine contained 5 per cent albumin; the bloody expectoration was profuse, the abdomen was distended (circumference, 45 inches) although general emaciation was notable. A uterine tumor was diagnosed as an interstitial fibroid and curettage was done the 8th, and the sound entered 15 cm.; cardiac failure; general œdema, partial anuria; and death the 19th. Microscopical examination of curettings showed hypertrophic glandular endometritis but no trace of malignancy. Autopsy findings, October 20: (1) Old standing pleuritic adhesions with numerous rounded masses of new-growth distributed through both lungs and similar nodules in the bronchial glands. (2) Enlargement of uterus from very large number of hard nodular fibroid tumors from mucosa to serosa, the uterine cavity empty and walls smooth. (3) In posterior wall of the bladder was a dark red rounded growth, a little elevated above the general mucosal surface; irregular and ulcerated upon the surface; with incrustations of salts. (4) In the wall of the sigmoid flexure was found a small dark red nodule. The tubes, ovaries, vagina, external genitals, and abdominal viscera were generally free from disease. Thorough microscopical study of nodules in bladder wall, sigmoid, and lungs showed all contained the same minute structure: (1) blood-clot, fibrin, and débris; (2) masses of syncitium; (3) collections of round and polygonal cells resembling cells of Langhans; (4) numerous large "giant cells" and cells of intermediate types. All the well-known and characteristic elements of the chorio-epithelioma were present. The syncitial and cellular masses also showed the marked tendency to invade blood-vessels and even to form thrombi in them, always regarded as one of the typical features of chorio-epithelioma.

Eden says, "Here are two authentic cases and at the extremes of life with the primary growth in one in the ovary and in the other in the bladder; and in both the uterus, vagina, tubes, and external genitals were not involved." He regards these as teratomatous cases the same as occur in the male.

But Devitzky's case differs from all the others by having its primary site in a structure that is not regarded as one in which dermoids or teratoma are found. Eden says he finds no record of a dermoid in the bladder. Devitzky, rejecting the teratomatous theory as to origin of the tumor in his case, thinks it arose from a wolffian duct. Eden thinks it may have arisen from the vesical mucosa by metaplasia.

Thus it is shown chorio-epithelioma exists in at least two forms; one arising from pregnancy, and the other, occurring in either sex, of teratomatous origin.

CAUSES

Some changes in the chorion bring about this malignant disease which follows molar pregnancy in from 36 to 41 per cent of cases; normal gestation 22 to 28 per cent; abortion 31 to 33 per cent, and from 2 to 7 per cent in ectopic gestation.

DEGREE OF MALIGNANCY

Schmauch (21) and others have decided that "the presence of plasmodium when not connected with a villus must always be regarded as a sign of malignancy. The assemblage of well-defined cells of the character of those forming the Langhans' layer, no matter what size or form, amongst healthy tissue or true plasmodium is, when found several months after expulsion of the ovum, an unmistakable sign of boundless growth." Teacher (22) says the degree of malignancy is less when villi are present. As villi are not present in the metastases they might be considered exceedingly virulent. And yet all are agreed that removal of a primary growth in the uterus generally lessens or abolishes the malignant feature of the metastases, and *vice versa*. Even curettage may remove the primary focus in the uterus, but the literature case records do not appear to support this plan of treatment, as the malignancy has not been materially lessened by that plan.

Strangely enough, partial removal of primary uterine foci (Noble) has resulted in cure. Perhaps the degree of malignancy depends on the origin of the primary growth. Findley (9) states that 16 per cent of hydatid moles are malignant, while others think the full-term pregnancy is more potent in that respect. No doubt the malignancy is of a high order yet, less so than carcinoma of the cervix or even of the body of the uterus. As a rule, however, the disease is not recognized early, as apparently it is capable of very rapid early advancement. Perhaps normal pregnancy delays the symptoms of hæmorrhage, one of the most constant early symptoms and as a result the disease is beyond eradication before discovered. E. P. Davis (5) says there are but two known cases of spontaneous cure.

TIME OF DEVELOPMENT RELATIVE TO PREGNANCY

Various authors have attempted to glean data on this feature in tables of cases. In Ladinski's (13) statistics, the average is eight weeks after molar pregnancy, seven weeks after abortion and five weeks after pregnancy at term. That it may occur or be recognized much earlier cannot be doubted. In my case it was incidentally found in a uterus containing a normal fœtus at the end of six weeks' gestation. *Au contraire*, in Caturani's first case the disease lay dormant five years after a mole was passed.

SYMPTOMS

The chief symptom of chorio-epithelioma of the uterus is hæmorrhage which is apt to be repeated and usually a few weeks after a full-term labor, an abortion, or the removal from the uterus of a molar pregnancy; there may be fragments of the growth passed. The uterus may contain a pregnancy that is apparently progressing normally and nodules, soft, dark gray in color, and later bleeding freely, he noted in the vagina. Metastases to lungs, liver, kidney, brain, or cord will give symptoms referable to those respective or-

gans. Usually pulmonary metastases have been mistaken for pneumonia. A primary focus in an ovary or the bladder may give symptoms referable to those organs and even the cystoscope may assist in discovering and noting the characteristics of the new-growth in the bladder.

DIAGNOSIS

As chorio-epithelioma is so constantly associated with pregnancy, either coincidentally or following, and its chief symptom, hæmorrhage, one often associated with some of the most frequent complications of pregnancy, labor at term, and abortion, it is likely not to be considered early in the case. The disease is of a nature so serious that uterine hæmorrhage of a persistent type occurring a few weeks or months after labor at term, an abortion, or a molar pregnancy should recall it to us. If nodules, having the characteristics mentioned, suddenly appear in the vagina at any time and especially during pregnancy or just after one has terminated in full-term labor, abortion, or the passage of a hydatid mole, and more particularly if symptoms appear that might be attributed to other metastases, then greater suspicion of the presence of this disease is proper. Rapid enlargement of the uterus (without reason to suspect pregnancy) into a doughy and perhaps fixed mass or enlargement of a too rapid or a too slow speed to conform to a known pregnancy may also suggest this disease. The microscopical examination of the tissues of chorio-epithelioma is sufficiently characteristic and constant as to leave little doubt.

PROGNOSIS

Krömer (12) has shown that but two cases have recovered without operation. Childress (4) has from a collection of 455 cases found that 68 per cent recovered after early radical operation after molar pregnancy; 58 per cent after abortions and full-term deliveries; and 33 per cent in ectopic gestation cases. Teacher collected 188 cases in which radical operation was performed 99 times with 63.3 per cent recoveries. Childress found recurrences in 11 per cent in from six months to two years, none of the series having been reported after two years.

Studying the case histories recorded, one is impressed by the many delayed operations and subsequent and fatal recurrences. Improvement lies in greater importance being accorded this disease, and earlier operations. Clinical evidence will usually be our guide, the microscope affording confirmation.

TREATMENT

The treatment should consist of early operation; as this is a disease that migrates through the large channels—blood-vessels—metastases may be expected to occur early and particularly if curettage is done. I believe strong suspicion of the existence of this disease in the uterus should be a sufficient indication for panhysterectomy. It is believed that we should never assume the uterus is free of the disease if it has been found in the chorion.

The disease is so fatal and the chances of extirpation by early operation so good that I believe greater benefit will arise from removal of the uterus without preliminary curettage, and possibly removing a small percentage of non-cancerous uteri, than from the curette and the danger incident to its use.

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AN UNUSUAL HÆMATOMA FOLLOWING LABOR

By CARL W. WAHRER, M.D., F.A.C.S., Fort Madison, Iowa

HÆMATOMATA of the pelvis following labor are not very rare especially in primiparæ. It is quite reasonable to suppose that the trauma of labor may often cause small collections of blood which are later absorbed without symptoms and are unsuspected by the obstetrician. These may be situated in the labia, the vaginal wall, the rectovaginal septum, and in the broad ligaments.

The records of the Lying-In Hospital of New York City show about one case of hæmatoma to every thousand labors. Rarely there occurs a type of hæmatoma in which the hæmorrhage is so alarming that the patients' life is endangered, collapse occurs, and operative interference is necessary to save the patient's life.

Williams, in 1904, collected thirty-three cases from the literature and added one of his own which he treated by abdominal section. Harrar reports three cases of this rare variety occurring in the Lying-In Hospital of the city of New York in 23,000 cases. The exact origin of the hæmorrhage is obscure but it is extraperitoneal and dissects up behind the pelvis or laterally in the broad ligaments. In some of the reported cases it seemed to come from the small capillaries at the base of the bladder or from the venous plexus in and about the bulbus vestibuli. It is not due to any lesion of the uterus. Another type of large hæmatoma is that due to incomplete rupture of the uterus. In such cases the mass is apt to be situated in the vaginal vault or in the broad ligaments and iliac fossæ. In the case I have to report the exact origin of the bleeding was not determined with certainty; it may have been due to an incomplete rupture of the uterus or may belong to the class of large hæmatomata without uterine lesion, as mentioned above.

On August 1, 1912, I was called to see Mrs. S., age 22, who had been delivered of her second child seventeen days before.

The family history was negative; as a girl she had enjoyed good health; she had been married three years. Her first labor two years previous had been easy and normal. During her second pregnancy her health was good; the labor was slow and the child which was born living, weighed 9 pounds. No instruments were used.

After waiting several hours the physician passed his hand into the uterus and removed the adherent placenta. There was no unusual bleeding at this time. When he saw her two days later she was rather pale, was flowing a little more than normal and complained of nausea. Her pulse was 90 and temperature 99°.

He was not called again till the eighth day when she had a slight chill and he found her with a temperature of 101°. At that time the uterus was irrigated with normal salt solution. During the eight days intervening between her first chill and the time I saw her the pulse and temperature rose slowly. On the fourteenth day the physician first noticed a large mass in the abdomen. He thinks it increased in size during the next three days.

When I saw her seventeen days after her confinement, I was struck by her excessive paleness. She was the whitest woman I have ever seen. The pulse was 170 and the temperature 104°. She complained of no pain in the abdomen, only a slight tenderness on pressure.

The mass occupied the entire right side of the abdomen rising from the pelvis and disappearing under the ribs and extending to the left beyond the median line. The abdomen was about the size of a seven months' pregnancy or possibly even larger although unevenly enlarged. The mass was smooth and rounded and quite firm. There was no tympany or vomiting or evidence of peritonitis. The patient had been somewhat constipated, but the bowels moved readily from enemata or cathartics.

On examination the uterus was movable although it could not be well outlined, the cervix was slightly enlarged and not torn; there was thickening and resistance in the right fornix but no distinct bulging into the vagina. There was a little bloody vaginal discharge. Although it was evident that the patient had lost a great deal of blood, we did not feel at all positive that the mass in the abdomen was a hæmatoma and exploratory operation was decided on with reluctance owing to the apparently hopeless condition of the patient. The abdomen was opened by a four-inch incision through the right rectus muscle. The mass was then revealed as a dark red tumor, retroperitoneal, and of the size mentioned above. It was in contact with the liver above and seemed to blend with the uterus and broad ligament below. So far as I could determine there was no evidence of free blood having been in the peritoneal cavity. The appendix was observed to be normal. Before a satisfactory examination

could be made the anæsthetist said that the patient was in bad condition and stopped the anæsthetic.

A large hæmostat was then thrust into the tumor and the blades widely separated. This was followed by a rush of black bloody fluid containing some organized clots. A handful of this material was removed and the cavity tamponed with gauze, the end of which was brought out of the incision as a drain. The patient rallied under stimulation and two hours later had a pulse of 120 and temperature of 102°.

On the fourth day her temperature was normal and the pulse 100. The wound drained a dark bloody fluid, never any pus, for about three weeks, at the end of which time the mass was about the size of an orange. It disappeared entirely in five weeks.

Her health has since been good. The interesting features of the case are the great size of the hæmatoma and the fact that the bleeding must have continued slowly for many days in order to have produced so large a mass without causing death.

INTESTINAL POLYPOSIS [1]

By W. C. CARROLL, M.D., Rochester, Minnesota
From the Mayo Clinic

INTESTINAL polyposis is a comparatively rare disease, occurring especially in the young and middle-aged. Its etiology is uncertain. Polypoid growths may occur at any point along the gastro-intestinal tract, but in the majority of cases they are found in the large intestine, usually at its turning points, and in the rectum. The size of the growths varies from a mere beginning up to the size of an orange. Occasionally they have been found at autopsy in persons dying from other conditions. Apparently these growths had not produced symptoms.

The following is a report of a case recently examined in the Mayo clinic:

Case (A 114,349) H. A. S. Male, aged 38, married. Examined September 2, 1914. One brother has tuberculosis; otherwise the family history is negative. The patient denies venereal diseases, but admits having indulged in alcoholics quite freely at times. He has had several attacks of malaria, but has otherwise always been well and strong up to three months prior to examination. The first symptoms noted were loss of weight and general malaise. At the onset he had also several spells of nausea and vomiting and some epigastric distress. During the last six weeks have occurred four attacks of sharp pain around navel and across upper abdomen, later becoming localized in the right iliac fossa. Nausea and vomiting accompanied each of these attacks, the most severe of which occurred three weeks before he came to the clinic. At that time nourishment had not been retained for three days. The attacks came on at about ten-day intervals, the last one a week previous, at which time he had a chill accompanied by temperature of 102.5 degrees, but no pain. Some degree of soreness had persisted in the right iliac fossa and a few days following the last attack a mass could be palpated and easily outlined in the right lower abdomen. Appetite good; bowels regular; loss in weight during last 10 months, 40 pounds. Systolic blood-pressure, 120 mm.; diastolic, 85 mm. Pulse, 100. Temperature, 98.8 degrees. Urine—specific gravity, 1,028, acid, no albumin, sugar, nor casts. Leucocyte count, 11,200.

In view of the history and physical findings, a diagnosis of an inflammatory tumor of the right lower abdomen was made and operation advised and accepted.

Operation. On September 4, 1914, he was operated on by E. S. Judd. A right rectus incision was made and the abdomen opened. The general exploration was negative except for the cæcum, ascending colon, and a portion of the transverse colon, which were thickened and firmer than normal. By grasping this portion of the bowel and passing it between the fingers the inner surface appeared to be covered with a papillary growth, and a diagnosis of papillary colitis or polyposis was made. A resection was done of the affected portion, which included six inches of the ileum, cæcum, ascending colon, and a portion of the transverse. An end-to-side anastomosis between the ileum and transverse colon was then made and the abdominal wound closed without drainage. The patient left the hospital on the fourteenth day and made an uneventful recovery.

Pathology. The gross appearance of the specimen is shown in Fig. 1. The entire mucous membrane is covered with growths, some of which form small rounded elevations; others on long pedicles, which vary in length and size, while in many places branched filaments are to be found.

Microscopically the mucous membrane consists of one layer of columnar epithelium similar to that which lines the normal intestine. There is a marked increase in the glands, which are long, tortuous, and

[1] Submitted for publication November 24, 1914.

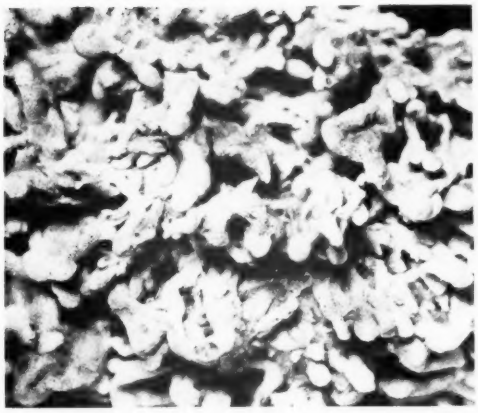

Fig. 1 (114,349). Marked polypoid growth, approximately actual size.

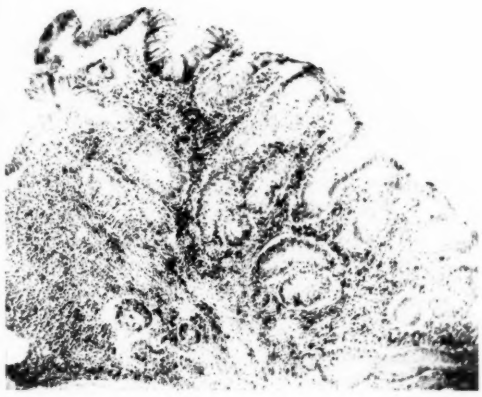

Fig. 2 (114,349). Section of a polypus showing the normal mucous membrane, increase in the glands, and lymphocytic infiltration.

branched. These glands are lined with columnar epithelium, among which are a great many goblet cells. In certain areas retained secretion, clinging to the surface of the cells, may be seen. Blood-vessels show some congestion, and the whole thickness of the specimen shows a distinct infiltration of lymphocytes (Figs 2 to 4).

Some observers have noticed a peculiar family tendency in these cases. Doering (1) states that Zahlman records an instance in which six brothers and sisters died of the disease.

Gastric polypi are similar in structure to those found in the intestine. They are usually found along the greater curvature near the pylorus. They may be adenoma, fibroma, myoma, or lipoma. Wade (2) describes a case of intussusception of the stomach and duodenum caused by the presence of a benign pedunculated fibroma. Gibson (3) cites a case of pedunculated polypus just inside the pylorus which caused intermittent obstruction—a ball-valve action.

Intestinal polypi may be single or multiple, the latter being more common. Rectal polypi are not uncommon and, according to Cripps (4), two common forms of polypi are to be found in the rectum: the fibrous type, which is a pedunculated tumor and composed for the most part of fibrocellular tissues, and the other the adenoid polypi, which are extremely vascular and consist of gland-tissue. These are usually single. Extremely rare conditions are the dermoid and the cystic polypi. Doering (1) states that there is a greater tendency to malignant degeneration in the rectum, and cites twenty-four cases of rectal polyposis, in which carcinoma was present in fifteen.

Occasionally cases have been seen at the Mayo clinic which, on proctoscopic examination, showed several polypi high up in the rectum. They were cauterized with the high frequency current. Microscopically they were of the adenomatous type. Another class of cases which have shown rectal polypi have been those of intestinal infection. These were also treated with the high frequency. In a few instances small carcinomatous polypi high up in the rectum, two to four in number, have been the means of making a diagnosis of a malignant growth higher up than could be reached with the proctoscope. These diagnoses have been verified by abdominal exploration.

The growths often cause obstruction and intussusception; the latter, in fact, is not of infrequent occurrence when marked polyposis exists. Bratrud (5) reports a case of intestinal polyposis with three distinct intussusceptions. Watts (6) also records a very interesting case of intussusception caused by these tumors which he was forced to operate on several times. At the first operation he reduced the intussusception. A week later

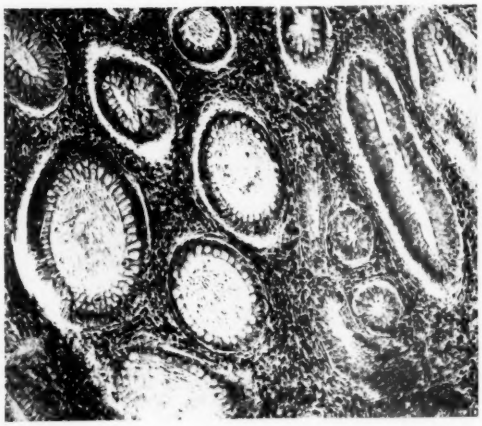

Fig. 3 (114,349). Higher power section showing glands containing many goblet cells.

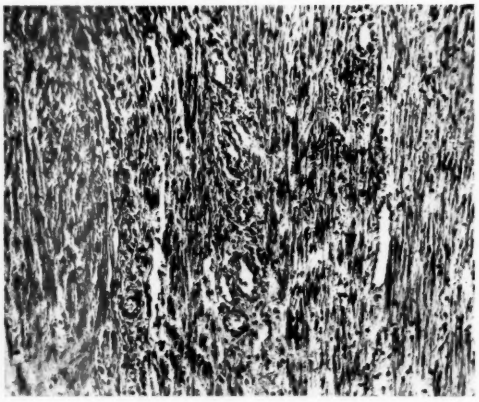

Fig. 4 (114,349). Section through the muscular coat, showing the marked lymphocytic infiltration.

the intussusception recurred, and he resected seventeen inches of the ileum, which contained two tumors. Two months later he resected a portion of the colon, and at a fourth operation, three months afterwards, four tumors were removed from the jejunum. Microscopically all these tumors proved to be adenoma.

Some observers maintain that the intussusceptions in such cases are caused by the mere weight and pulling of the tumor on the intestinal wall as it is being pushed forward by the intestinal peristalsis and the stream of intestinal contents. Others, however, contend that the presence of the tumor excites violent peristalsis, which causes the invagination. If the first theory were true, the tumor would always occupy the apex of the intussusception, but this is not the case.

Symptoms. The symptoms usually vary with the position, size, and number of the polypi. Rectal polypi are usually easy to discover by proper rectal examination and may be seen with the proctoscope. Regardless, however, of the location of the growths, they usually produce hæmorrhage sooner or later. Anæmia in these cases varies according to the extent of the hæmorrhages. Diarrhœa may become very profuse at times, rectal tenesmus may be present, and vague abdominal symptoms, as colic and obstruction, also occur. Eosinophilia may be present in this as in other intestinal conditions.

According to Doering (1), the diagnosis can only be made when the polypus is seen or felt. He collected all the cases reported up to 1907, and out of the fifty-two which he reviewed only one patient was perfectly well after four years.

Treatment. Therapeutic treatment is useless. Depending upon the size and number of the polypi and extent of intestine involved, simple excision of the tumor itself or resection of the bowel may be necessary. In many cases the involvement may be so extensive as to preclude even surgical interference.

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THE KINETIC THEORY OF PERITONITIS[1]

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

INTRODUCTION

IT is my purpose in this paper to present a new explanation of the phenomena which accompany peritonitis and to outline the treatment suggested by this conception.

In the abdomen the leading symptoms of peritonitis are pain and tenderness, distention, muscular rigidity, intestinal paresis, vomiting. In addition to these local disturbances there are also the general symptoms of infection: accelerated pulse and respiration, raised blood-pressure, fever, and rapid loss of strength and weight. I postulate that these are all adaptive phenomena; that is, that each individual phenomena of peritonitis has been evolved for the good of the individual. In other words, the whole process is for the purpose of defense against injury just as truly as physical fighting is for the purpose of defense against attack. In like measure physical fighting and the body's defense against peritonitis are dependent on the transformation which is effected by the kinetic system. In peritonitis, as in the case of a physical attack, the defense may require so rapid and so extensive a transformation of the body's stores of energy that exhaustion, or even death, may follow. It follows, therefore, that in peritonitis, as in fighting or in any form of physical exertion, safety may lie in the control of the kinetic system.

ANALYSIS OF THE PHENOMENA OF PERITONITIS

As the abdomen has within it a germ-laden intestine, and as it was a part of the body that was frequently wounded in man's phylogenetic struggles with his environment, the peritoneum, perforce, through natural selection acquired a remarkable power of self-defense against the consequent infections.

Fig. 1–A. Section of cerebellum of rabbit, normal. Photomicrographs (x310) showing the effect of diphtheria toxin on the brain-cells and the protection afforded by morphine.

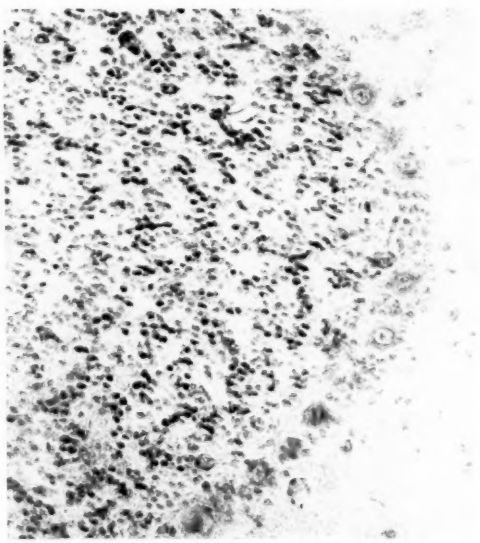

Fig. 1–B. Section of cerebellum of rabbit after injection of diphtheria toxin. Note the general hypochromatism. Photomicrograph (x310) showing effect of diphtheria toxin on the brain-cells and the protection afforded by morphine.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 18, 1914.

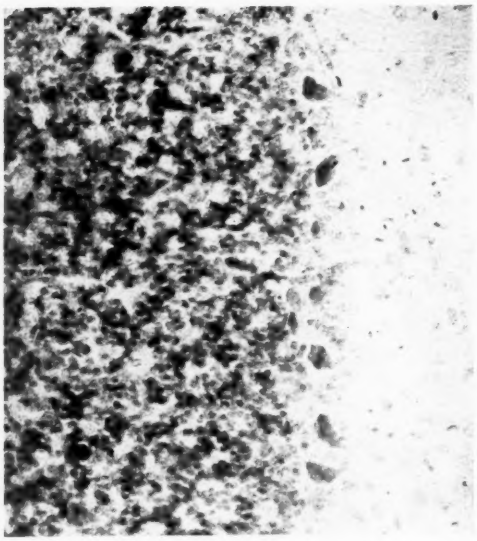

Fig. 1–C. Section of cerebellum of rabbit after injection of diphtheria toxin and morphine. The protective effect of morphine is illustrated by the presence of hyperchromatic cells. Photomicrograph (x310) showing effect of diphtheria toxin on the brain-cells and the protection afforded by morphine.

As an infection is most readily spread and increased by movement, immobilization is the prime requirement in overcoming an infection. Within the abdomen this immobilization is accomplished (a) by inhibition of the intestines; (b) by distention of the intestines; (c) by rigid and persistent contraction of the abdominal muscles; and (d) by the exudation of a sticky glue-like material. The infected point in the peritoneum may therefore be completely fixed (a) by paralysis, (b) by distention, (c) by rigidity of the abdominal wall, and (d) by gluing.

On account of the intestinal inhibition, digestion and absorption cease and anorexia and vomiting follow — self-protective measures which have been evolved against the danger from poisonous broken-down food.

We see, therefore, that the paralytic distention of the intestines, the muscular rigidity of the abdominal walls, the anorexia, and the vomiting which accompany peritonitis are natural adaptations for the purpose of localizing and overcoming the infection. As for the pain and tenderness, they are part of the protective mechanism and play their rôle by forcing the body to maintain a boxlike rigidity of the abdominal portion.

When the abdomen is rigid it can no longer play its important respiratory rôle, and the respiratory movements are confined to the thorax; in fact, the lower thoracic movements also are inhibited, since the movable ribs are fixed on the abdominal side. As the lungs are but partially filled, the respiratory rate is increased to compensate for the diminished volume of the exchanged gases. The diminished respiratory movements of the lower chest induce vascular congestion; vascular congestion induces pleurisy and pneumonia.

The loss of water by vomiting, the diminished intake of water, and the failure of water absorption cause a rapid shrinkage of the soft parts, which is especially noted in the face, while the increased blood supply to the intestines, combined with the diminished intake of water, causes a rapid diminution of the pulse

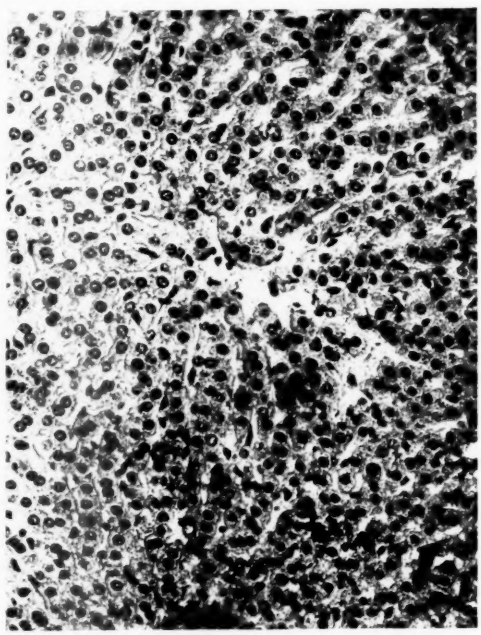

Fig. 2–A. Section of liver of rabbit, normal. Photomicrographs (x310) showing the effect of diphtheria toxin on the liver and the protection afforded by morphine.

volume. The loss of water is followed also by a diminished volume of urine. At the same time metabolism is increased; there is an increased concentration of solids which cannot be eliminated by the kidney, handicapped, as it is, by the diminished urinary output. The skin, in turn, therefore, is forced to attempt by increased activity to compensate for the renal insufficiency.

We see, therefore, that the *characteristic* phenomena of peritonitis are as natural as the phenomena of walking, running, or fighting. The increased pulse and respiratory rate and the fever are characteristic not of peritonitis alone, but of all infections. They are the result of the *forced* conversion of potential energy into kinetic energy as a defense. This defense also is an adaptation developed in the body by natural selection and is the means by which foreign proteins — infection products — are broken down.

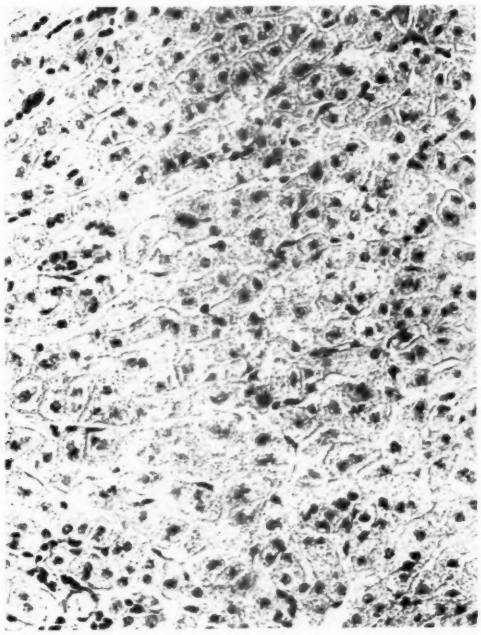

Fig. 2–B. Section of liver of rabbit after injection of diphtheria toxin. Note the poorly stained cells, their irregular outlines, the vacuolated spaces and loss of cytoplasm. Photomicrograph (x310) showing the effect of diphtheria toxin on the liver and the protection afforded by morphine.

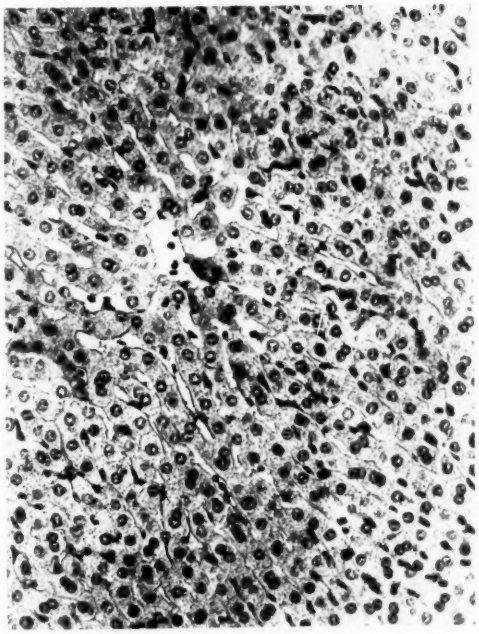

Fig 2–C. Section of liver of rabbit after injection of diphtheria toxin and morphine. Note the regular arrangements of the cells and the even distribution of cytoplasm in contrast with the general disorganized condition of the cells in B. Photomicrograph (x310) showing the effect of diphtheria toxin on the liver and the protection afforded by morphine.

THE TREATMENT OF PERITONITIS

If the body-wide disturbances caused by peritonitis are adaptations for defense then we must conclude that death is caused by an excessive discharge of the body's store of energy in maintaining this defense. Our problem, therefore, must be to discover some means by which the method of defense evolved by nature may be maintained while at the same time the energy of the body is conserved as far as possible.

The evidence upon which we base our postulate that the excessive transformation of potential into kinetic energy is the cause of death in peritonitis points the way to the method by which the energy may be conserved.

1. In experimental researches my associates — Drs. J. B. Austin, H. C. Sloan, F. W. Hitchings, and M. L. Menten — and I have

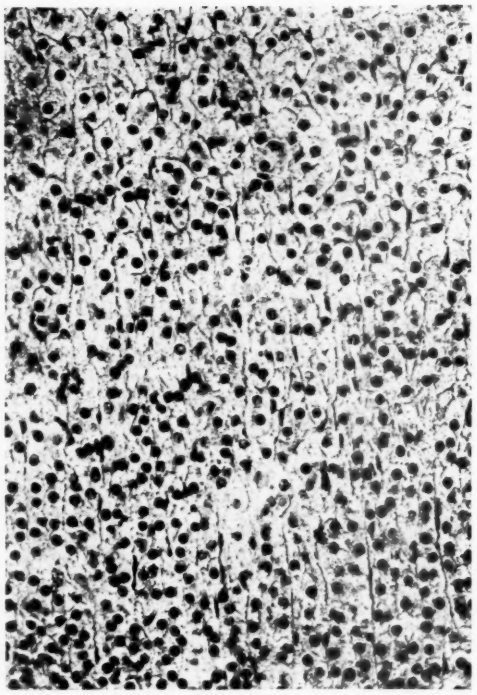

Fig. 3–A. Section of adrenal of rabbit, normal. Photomicrographs (x310) showing the effect of diphtheria toxin on the adrenals and the protection afforded by morphine.

found that infection produces in the brain, the suprarenals, and the liver histologic changes which are identical with the changes which are characteristic of exhaustion from any cause, such as running, fighting, trauma, etc. Exhaustion from any cause, as we have shown elsewhere, is invariably accompanied by widespread histologic changes in these three organs — the brain, the suprarenals, and the liver — these changes, according to the degree of exhaustion, varying from slight hyperchromatism through stages of chromatolysis to a final stage of disintegration.

2. Our experimental researches have shown us also that deep morphinization prevents the histologic changes which are characteristic of the excessive conversion of energy, Figs. 1, 2, 3; that is, of exhaustion.

Not only is the conversion of energy excessive in cases of peritonitis, but, as we have stated already, the intake of energy in the form of food fails, so that the stores of energy are depleted with great rapidity, while the action of the kinetic system is still further impaired by the loss of water equilibrium.

These facts point the way to two prime requisites in the treatment of peritonitis: (a) the conservation of energy by the use of morphine, and (b) the maintenance of the water equilibrium by the Murphy rectal drip.

Morphine not only protects the organs but it also aids in promoting the efficiency of the defense mechanism within the abdomen, for deep morphinization of itself causes inhibition of the intestine, immobilizes the patient as a whole, prevents pain, and holds metabolism practically at a standstill. Under deep morphinization but little food is required, the brain, suprarenals, and liver are protected, and the intestines are immobilized

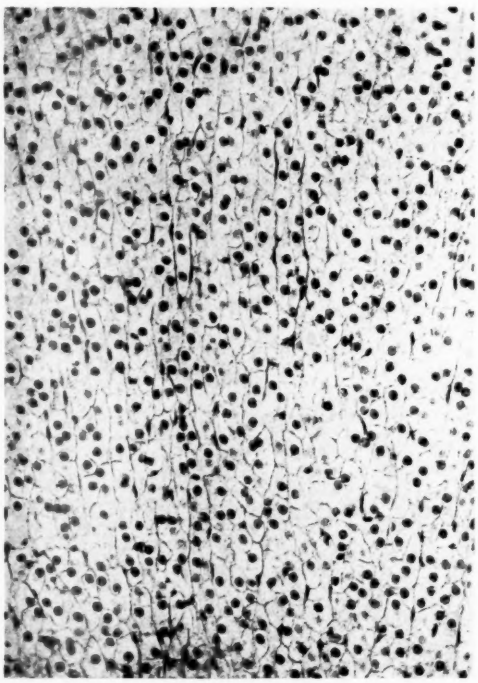

Fig. 3–B. Section of adrenal of rabbit after injection of diphtheria toxin. Note the general disappearance of the cytoplasm. Photomicrograph (x310) showing effect of diphtheria toxin on the adrenals and the protection afforded by morphine.

while the phagocytes overcome the infection. That deep opium narcotization is a very efficient treatment for peritonitis was well known to the older clinicians, especially to Alonzo Clark and to Flint, who gave opium until the respirations were far below normal, as low even as ten or twelve per minute.

The appearance of these patients would seem to indicate that they are perilously near death; in reality they are in a condition which closely resembles hibernation, and which continues until the local immunizing forces overcome the infection.

In cases of appendicitis with spreading peritonitis, the surgeon should never, in the whole scheme of treatment, lose sight of this prime need of protecting the kinetic system from exhaustion. The administration of morphine should therefore begin at once. Nitrous oxid is the inhalation anæsthetic of choice, as ether, by dissolving the lecithin in the phagocytes, causes a weakening of the body's defense, which may last from twenty to twenty-four hours — a break in the defense which may cost the life of the patient. The operation is performed under anoci-association, the local field being blocked as far as the zone of actual infection. Morphine is continued during and after operation, as is required to conserve the patient's energies.

My associate, Dr. Lower, and I have employed this method in 391 cases of acute appendicitis with but two deaths.

We may define peritonitis as the adaptive phenomenon manifested by the kinetic mechanism in maintaining a defense against an infection of the peritoneum, and we find that the kinetic theory supplies a consistent explanation of the phenomena of peritonitis and also a true index to its successful treatment.

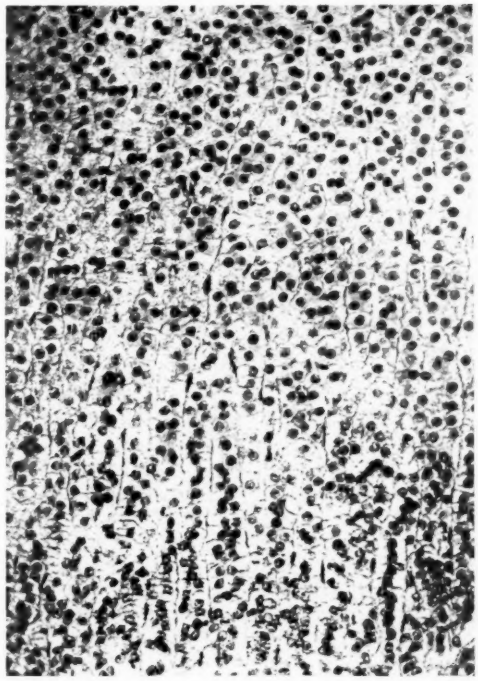

Fig. 3–C. Section of adrenal of rabbit after injection of diphtheria toxin and morphine. Note the general presence and even distribution of cytoplasm in contrast with its disappearance in B. Photomicrograph (x310) showing effect of diphtheria toxin on the adrenals and the protection afforded by morphine.

SARCOMA OF BOTH OVARIES IN A CHILD OF THREE YEARS[1]

By F. H. SMITH, M.D., and J. COLEMAN MOTLEY, M.D., Abingdon, Virginia

IN October, 1912, we performed double ovariotomy for bilateral tumor of the ovaries upon a child of three years.

This experience led to a search for recorded cases of tumors of the ovary in young children, especially of solid tumors, and closest attention has been directed towards report of bilateral tumors. The results of this search, with the report of our own case, is the material of this paper.

Broad statements as to the frequency of occurrence of solid ovarian tumors in childhood and direct reference to recorded cases seem to vary widely. As instances leading to the supposition that carcinoma, at least bilateral carcinoma, is quite common in

[1] Read at the session of the Medical Society of Virginia, Washington, D. C., October 27, 1914.

Fig. 1. Gross specimen. Note nodular potato appearance.

Fig. 2. Gross specimen. Note solid meaty appearance.

childhood, one may cite the following statements: "Bilateral carcinoma is very common," (Klauhammer, 1). "Cancer of the ovary is not very rare in children, and bilateral cancer is common," (Dreyfus, 2).[1] And "Ovarian carcinoma in children is reported in large numbers by Olshausen, Gussenbauer, and Kaltenbach, etc." (Berent, 3). Yet Jochmann (4) in 1898 could collect only thirty solid tumors of all sorts during childhood. Hubert (5) in 1901 could find only one hundred seventy-five including children as old as 17 years; and Wiel (6) in 1904, asserts that carcinoma of the ovary is very rare in young children, and that his is the fourth case reported for the removal of the growth. In explanation of the discrepancy it may be that one refers to all observed cases, operated or not; the other, only to operated cases. Surely operated cases are not common, for Spencer Wells, out of one thousand ovariotomies had only three in children; Schauta, three out of three hundred ninety-four; and Olshausen had only sixteen in children out of 1,716 ovariotomies. And these figures refer to ovariotomy for all conditions in childhood. In the material at the Budapest Stefania Children's Hospital, during the four years preceding 1905, among the 71,101 diseases during childhood, ovarian tumors were found in only four (7).

There is striking uniformity, on the other hand, as to the relative frequency of malignancy among all reporters. While cystadenoma and embryoma are the most common, carcinoma and sarcoma embrace 34 per cent (Winternitz and Finaly); or, of Hubert's list, 34.29 per cent; and of Wiel's, 31.81 per cent whereas of 1,239 ovariotomies of adults, only 47, or 3.8 per cent, were sarcomatous (Hubert). Because, then, the tumor is usually malignant, Gross (8) says that the prognosis in ovarian tumor is serious; they grow very rapidly, and the younger the child the more rapid the growth. Carcinoma and soft round-cell sarcomata give the poorest prognosis, they are more commonly bilateral; while the hard spindle-cell growth is usually unilateral and shows little tendency to metastasis. Fibrosarcoma gives the best chance, but is infrequent in children (Berent).

With such figures in mind no one can dissent from the opinion that the therapy of ovarian tumors in childhood is always operative, and should be instituted immediately after arriving at a definite diagnosis; in benign tumors on account of the constant growth and marked symptoms. Without it one cannot tell whether malignant degeneration has occurred or not. In malignant tumor, of course, operation is imperative, though operation during childhood does not give a very good prognosis as a whole (Klauhammer).

In connection with the prognosis of malignant disease after operation, statistics are notably unreliable. "It must be borne in mind that many cases are reported merely because there was recovery, while it may be assumed that some eases with unfavorable issue are unrecorded. Furthermore, many of the reporters mean by recovery merely immediate recovery, though death may have occurred from metastasis later. We can only take the figures as we find them." (Wiel.)

Aldibert is quoted (1) as placing the mortality after operation in solid ovarian tumors at 59 per cent; in cystic tumors, as low as 11.2 per cent. Bland-Sutton's mortality was 58.3 per cent (Page, 9). Kelly speaking in general says that operation on children is attended by a mortality of more than one half (Wiel). Hubert could follow twenty-four sarcoma cases after operation; in eleven a successful result followed; while in thirteen

[1]Dreyfus may mean, relatively speaking, for in the same connection he says: "Cancer of the ovary . . . . is encountered once in every 12 affections of the adnexa requiring laparotomy" (in children?)—F. H. S. and J. C. M.

death occurred directly or as the result of metastasis. Of Wiel's cases, the mortality after ovariotomy for sarcoma is 42.9 per cent, with the result unknown in 8.3 per cent more, in children of 5 years and under.

In our search for recorded cases at the Surgeon General's Library our attention has been attracted to the work of Jochmann (4), who in 1898 recorded twenty cases of solid tumor (list of cases not available); of Hubert (5), who in 1901 recorded 175 of both cystic and solid tumor, to the age of 17 years—

Benign Tumors:	
Dermoids	39
Cystomata	19
Cysts	53
Hæmatomata	4
Malignant Tumors:	
Carcinomata and cystocarcinomata	28
Endotheliomata	4
Sarcomata and cystosarcomata	28
Total	175

—and of Wiel (6), who in 1904 and 1905 found 60 operated cases to the age of 10 years—

Dermoids	22
Teratomata	1
Cysts	16
Papillomata	3
Carcinomata	3
Sarcomata	15
Total	60

These compilations are regarded as complete to their respective dates and within the limits of their respective titles. We might remark, therefore, that in introducing our own table only six were reported prior to Hubert's dissertation, and none is in Wiel's list, though there are several in our table reported prior to Wiel's paper, omitted by him because of the limitation of his title. In none of these compilations is a bilateral case reported. We have here introduced into the paper a table of all of the cases of ovarian tumor in children, some as old as 16 years, which we have been able to find record of, under the name of the reporter, mentioning the age of the child, the nature of the tumor, the results of the operations, and, finally, the original reference when it can be found:

In this list of forty-seven cases, one will note three cases in which the tumor was found at autopsy, and one was a pathological specimen; they are included in the list because we wished to make it as complete as possible.

Summarizing the table with reference to the nature of the tumor:

Dermoids	3
Cysts	6
Cystomata	2
"Polycystic tumor"	1
Cystic adenoma	1
Cystic embryomata	3
"Solid tumors"	2
Teratoma	1
"Teratoma with carcinoma"	1
Teratoma chorioepithelioma	1
Hypernephroma ovarii	1
Endothelioma lymphatosum	1
Carcinomata	8
Sarcomata	16
Total	47

Of these the following are bilateral; the only bilateral cases we are able to find definitely recorded:

1 bilateral dermoid, child 11½ years, (Legueu).
1 bilateral carcinoma, child 14 years, (Kouznetsky).
1 bilateral teratoma, child 14 years, (Kartuschanskaja).
1 bilateral sarcoma, child of 13 years, (Croom).
1 bilateral sarcoma, fœtus of 7¾ months, (Doran).
1 bilateral carcinoma, involving the second from the first ovary, child of 12 years (Martland).

The mortality figures are hardly interesting, as the result in so many is unknown. We tabulate the mortality, at any rate:

Total cases	47
Less autopsy and fœtal case	4
Workable cases	43
Recovered	21 or 48.77 per cent
Died, 10 or 23.26 per cent Unknown, 12 or 27.91 per cent	22 or 51.17 per cent

Of the carcinomata and sarcomata:

Total cases	25
Less autopsy and fœtal cases	4
Workable cases	21
Recovered	7 or 33.83 per cent
Died 6 or 28.57 per cent Unknown 8 or 38.09 per cent	14 or 66.66 per cent

We add now, our own case in abstract:

Case: One of us (Dr. S.) was called October 21, 1912, by Dr. James W. Cummings, of Abingdon, to a white girl, age 3 years, who had been complaining of recurrent attacks of abdominal pain, of constipation and nausea and vomiting for a month, with a mass in the abdomen discovered 3 days ago. The child was the next to the youngest of a family of eight children, all living and in good health, except two dead of pneumonia and summer complaint. This child had been well until a month ago, when it became ailing with digestive symptoms taken to indicate worms or biliousness. Calomel, santonin

OVARIAN TUMORS IN CHILDREN

Reporter[1]	Age	Tumor	Result	Reference
Budin	14½	"Solid tumor"	Death	Bull. Soc. Anat. de Paris, 1, 28, xx.
Krukenberg	8	Carcinoma	Recovery	Berl. klin. Wchnschr., xxv, 855.
Doran	Fœtus[2]	Sarcoma (double)		Tr. Path. Soc., London, 1889.
Croom[3]	13	Sarcoma (double)	Recovery	Edin. M. J., 1893, February.
Kruge	11	Myxosarcoma	Death	Dissertation, Marburg, 1894.
Jochmann	4	Sarcoma	Autopsy	Dissertation, Freiburg-in-Baden, 1898.
Bonnar	13	"Ovarian tumor"	Recovery	Indian M. Rec., xx, 110.
Hubert	11	Endothelioma	Recovery	Dissertation, Giessen, 1901.
Leopold[4]	14	Sarcoma	?	Quoted Berent, Dissertation, Berlin, 1901.
Wagner[4]	13	Sarcoma	Death	Quoted Berent, Dissertation, Berlin, 1901.
Brown[4]	¾	Carcinoma	Autopsy	Quoted Berent, Dissertation, Berlin, 1901.
Spencer Wells[4]	13	Carcinoma	?	Quoted Berent, Dissertation, Berlin, 1901.
Klebs[4]	10	Carcinoma	Recover	Quoted Berent, Dissertation, Berlin, 1901.
Berent	11	Carcinoma	Death	Dissertation, Berlin, 1901.
Legueu[5]	11½	Dermoi l (double)	?	Quoted Walther, Dissertation, Leipzig, 1911.
Machard[5]	14	Dermoid	Recovery	Quoted Walther, Dissertation, Leipzig, 1911.
Heaton	9	Cyst	?	Brit. M. J., 1901, Nov., p. 1559.
Coignerai	14	Myxosarcoma	?	Thèse de doct., Par., 1902.
Pick	9	Teratoma	Death	Berl. klin. Wchnschr., xli, p. 158.
Kouznetzky	14	Carcinoma (double)	Recovery	Ann. Gynec. et Obst., 28 1, 191.
Erdmann	13	Cyst	Recovery	J. Am. M. Ass., 1905, May.
Michel	16	Carcinoma	Death	Zentralbl. f. Gynäk., xxxix, 422.
Winternitz and Finaly	11	Cystic embryoma	Recovery	Jahrb. f. Kinderh., lxii, 402.
Winternitz and Finaly	6	Simple cyst	?	Jahrb. f. Kinderh., lxii, 402.
Winternitz and Finaly	6½	Cystic embryoma	Recovery	Jahrb. f. Kinderh., lxii, 402.
Winternitz and Finaly	9	Dermoid	Recovery	Jahrb. f. Kinderh., lxii, 402.
Kartuschanskaja	14	Teratoma (double)	Recovery	Dissertation, Zürich, 1906.
Sprengel	10	Cystoma	Recovery	Deutsche Chir., xlvi, p. 444.
Arungan	10	Multilocular cyst	Recovery	Brit. M. J., v, No. 1, 1363.
Dreyfus (or Donnhauser)	13	Adenosarcoma	Death	By Dreyfus, Thèse de doct., Par., 1907.
Erdmann	13	Sarcoma	Death	Ann. Surg., Phila., xlviii, 619.
Bornstein	13	Cyst	Recovery	J. Am. M. Ass., liii.
Martland	12	Teratoma with carcinoma (double)[6]	Death	Proc. N. Y. Path. Soc., n. s. ix, 125.
McMullen	16	Multilocular cyst	Recovery	Brit. M. J., 1, p. 1281.
Walther	2¾	Cystic adenoma	Death	Dissertation, Leipzig, 1911.
Walther	12	Cystoma	Recovery	Dissertation, Leipzig, 1911.
Rosanoff	5	Medullary carcinoma	Recovery	Deutsche med. Wchnschr., xxxvii, 234.
Fenomenoff	8	Sarcoma	?	By Rosanoff, Deutsche med. Wchnschr., xxxvii, 234.
Bazy	13	Myxosarcoma	Recovery	Bull. et mém. de chir. de Par., xxxvii, 664.
Bazy	16	Polycystic tumor	Recovery	Bull. et mém. de chir. de Par., xxxvii, 664.
Savoriaud[7]	3	Fusocellular sarcoma	?	Bull. et mém. de chir. de Par., xxxvii, 639.
Gaudier[7]	4	Hypernephroma ovarian	?	Bull. et mém. de chir. de Par., xxxvii, 639.
Gross	14	Fibrosarcoma	?	Prog. med. Wchnschr., xxxvii, 70.
Klauhammer	7	Cystic embryoma	Recovery	Dissertation, Jena, 1912.
Mond[8]	15	Sarcoma	?	Dissertation, Jena, 1912.
Kayser[9]	10	Myxo endothelioma sarcoma	?	Dissertation, Jena, 1912.
Lesage and Girault	1	Sarcoma	Autopsy	Arch. de Med. d. Enf., xvi, 207.

[1]In each case we have given the name of the original reporter, with the original reference, even though the information is obtained through another citation.

[2]Listed because of the fact that it is a bilateral tumor.

[3]Cited by Martin, and quoted by Berent.

[4]Cited by Berent, 1901.

[5]Cited by Walther, 1901.

[6]Tumor involved one ovary at first operation; second attempt to remove failed; at third operation, 3 weeks after first, other ovary was also involved.

[7]Cited by Guibal, 1911.

[8]Klauhammer states that Mond exhibited specimen removed from child of 15 years.

[9]Klauhammer's authority.

and oil were repeated several times, with little improvement. Unsatisfactory results were obtained from all purgatives. The child was lost sight of for two weeks, when again the symptoms returned, met by the same treatment, with like results. Appetite was now poor, marked tendency to nausea, bowels obstinately constipated, distention unless the bowels moved thoroughly, and from time to time colicky abdominal pains. Three days before, abdominal pain became worse, tenderness developed for the first time, vomiting was more frequent. No fever had been noted at any time. Dr. Cummings found a mass in both flanks, and recalled that three and one-half weeks ago he felt in the right iliac fossa an indefinite, doughy mass, which he feared might be of appendiceal origin, but the absence of fever seemed to negative this, and he lost sight of the mass when the symptoms remitted. The mother said that the tumor changed size and shape very much in a little while. Did not know that defecation influenced either, but knew that it certainly relieved the pain. She also commented on the fact that one minute the child might play about the room as if nothing were wrong, and in a few minutes would be doubled up with pain; the abdomen was quite sensitive; there was much nausea; vomited several times, when all symptoms would pass off again, and the child would be comfortable. For three days, no satisfactory defecation, in spite of calomel, oil, and several enemata. This day she has vomited six or seven times. Upon inquiry the mother remembers that the child had been butted in the abdomen by a goat a few weeks before the first complaint, no immediate ill effects.

Upon examination, the child seemed healthy and well nourished, mentally alert, and apparently in no pain. Temperature normal, pulse 103. Negative except for the abdominal findings. The abdomen was asymmetrical; a mass in each iliac region. General distention, upper portion tympanitic, but otherwise negative. No tenderness anywhere. In the right flank there was a palpable mass, extending into the abdomen downward and inward parallel with Poupart's ligament to the symphysis, where it seemed interrupted in the middle line and then continued, or else another mass could be felt, in the same region of the left abdomen. The masses were solid yet doughy, not tender, irregular sausage-shaped; the two moved independently, but no motion imparted to one could be transmitted to the other. Upon rectal examination the right sided mass was felt, as it were, "end on," the finger almost passing around its lower pole. The left sided one could also be felt, apparently not connected with the other. Otherwise nothing new was learned.

White blood-cells, 18,000 per cmm.; differential showing polymorphonuclears, 63 per cent, small mononuclears, 29 per cent, large and transitional mononuclears, 7 per cent, eosinophiles, one per cent. The urinary report is missing, but it was essentially negative.

The diagnosis of ovarian tumor was suggested at consultation and largely accepted, but because of the fact that such a condition in so young a child was unheard of by any of us, Dr. S. was persuaded out of his conclusion and accepted the diagnosis of chronic, partial obstruction of the bowel from an unknown cause. The patient was removed to the Abingdon Hospital and immediately prepared for operation proposed to relieve the obstruction.

Operation, October 22, 1912; Dr. Cosby anæsthetist; ether, three ounces; Dr. Motley operating, assisted by Dr. Smith.

Straight incision to the right of the median line. A large, sausage-shaped mass in the right flank, the identity of which was confusing because of dense adhesions of omentum and of coils of bowel looped around the omental adhesions, producing obstruction, and also because of a long tube-like structure adherent to the upper pole of the tumor. Right and left kidneys were identified, the adherent structures separated, when the broad ligaments and the infantile uterus could be recognized, then the tumor identified as ovarian or parovarian. Removed after ligation of pedicle. The left-sided tumor was approached in the same manner. But there were no adhesions on this side, and the long tube-like structure was not present to complicate matters. Removed in the same way. Abdomen closed by through-and-through sutures.

Normal post-operative course, until interrupted by a pneumonic consolidation of the right base on the sixth post-operative day, resolving on the third day. Bowels moved on third day by enema and each day thereafter; urine in good amount after second day. Discharged on the twenty-third day, normal except for infrequent nausea.

The tumor was submitted for pathological identification to Dr. B. C. Willis, pathologist, Richmond, Va. By him they were shown to Dr. Louis B. Wilson of the Mayo Clinic. Drs. Willis and Wilson report that the tumors were embryomata, that recurrence would take place, and the recurrent tumor would be of the nature of sarcoma.

On March 15, 1913, patient was readmitted to the Abingdon Hospital, her mother having discovered abdominal masses three days before.

Since her former discharge the patient has been well, until three nights ago, the mother on picking the child up from the floor felt a mass about the region of the navel. That night following enema, acute abdominal pain, requiring paregoric. When examined next day, a large central mass was found, apparently a tumor of the omentum, centering about the umbilicus, with several other tumors scattered about over the abdomen, as far around as the flanks. Urine negative. Blood picture about as before. A diagnosis of abdominal sarcomatosis was beyond question, Dr. Wilson's prediction having been all too well fulfilled; she was referred to numerous physicians by her father, all confirming the diagnosis and refusing to advise operation, with death ensuing in May, 1913. No autopsy was permitted.

Dr. Willis has been so kind as to furnish us with a pathological description of these tumors, and with photographs and microphotographs of the specimens, and has added embryological data which enable us to get our bearings. He reports that macroscopically the tumors were covered by peritoneum, and measured, the right, 13 x 17 cm; the left, 7 x 15 cm. They felt solid to the touch with smooth protuberances at irregular intervals, giving them much the appearance of Irish potatoes. On section, they were solid throughout, and of a distinctly meaty appearance, with small blood-vessels scattered throughout (see photographs of the gross specimen). Microscopically, the tumors were very similar in structure. In areas, there were solid masses of embryonal cells with practically no intercellular stroma; in others, there were remains of tubules under great pressure. The individual cells were of very immature type, no outer cell-wall could be distinguished, and were surrounded by very little protoplasm.

So then, these tumors belong to the broad class of embryoma; a mixed tumor derived from all three layers, epiblast, mesoblast and hypoblast. But the malignant sarcomatous stamp is fixed upon them by the preponderance of the mesoblastic tissue. It was this feature which prompted Dr. Wilson to predict a sarcomatous recurrence. Furthermore, it might be interesting to recall the close kin between embryoma and teratoma, and in this relation to note that Martland's case, included in our paper, one of the few bilateral tumors found, was finally decided by a committee to which it was referred for study to be "probably a three-layer embryoma or teratoma of the ovary showing carcinomatous changes." (12)

The parovarium, the epoöphoron, or the organ of Rosenmüller, as it is variously called, "consists of a group of tubular structures lying transversely within the broad ligament, between the ovary and oviduct. It represents the partially obliterated remains of the Wolffian body and duct" (10), the latter being practically synonymous with the mesonephros. The mesonephros is, in turn, derived from the primitive segment stalks which project into the primitive body-cavity as the urogenital ridge, and from these stalks material is derived for the development of all three excretory organs, including the mesonephros. The greater portion of the mesonephros and its duct (i.e., the wolffian body and its duct) atrophies, but the upper portion of the duct persists in the female as the parovarium (11): an important point in the present case because it is from a prenatal rest composed of this tissue that we believe these malignant tumors were developed. Strictly speaking, then, the tumors in our case were parovarian embryomata with sarcomatous (mesoblastic) elements predominating

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THE EXCESSIVE MORTALITY OF HIGH INTESTINAL OBSTRUCTION[1]

With Report of Cases

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THERE is probably no field of surgical research at the present time that is of more interest and importance than the cause of the excessive mortality in high obstructions of the small intestine. Until the last year or two not even a plausible explanation has been offered. While the death rate due to complete obstruction in any part of the small intestines is high, yet it has long been recognized that the rate is higher when the seat of obstruction is in the upper jejunal and duodenal tract. While due consideration has been given to the prior investigations of Murphy and Vincent,[2] of Roger, and a few others, it is perhaps only necessary on this occasion to refer to the more recent investigations of Whipple, Stone, and Burnheim of Baltimore[3] and of Hartwell, Hoguet, and Beekman of New York and the recent work and articles by Draper.[4]

These investigations have given the chief important bibliography and data to the present time. The experiments have been made mostly on dogs, the details of which it is needless to attempt to give on this occasion. The conclusions of Whipple, Stone, and Burnheim are that death is due primarily and chiefly to a poison secreted, or produced, by the duodenal mucosa and stagnant contents above the seat of obstruction, and that the loss of water from the tissues into the paralyzed distended intestine and stomach is a secondary phenomenon.

Hartwell, Hoguet, and Beekman conclude that death is due first to the excessive water loss which regurgitates into the stomach and is vomited; and secondly to a toxin which is the result of bacterial invasion of the paralyzed and traumatized intestinal wall. Both schools, New York and Baltimore, agree that general bacteræmia, though plausible, is not tenable. These investigations seem conclusive in many respects, but it probably cannot yet be affirmed that the cause of death is fully and finally determined. However, the future seems bright and more promising of good results, which is the aim of all investigations. The supreme test in every instance is the final application of all animal experimentation and laboratory results at the bedside. In the past year I have operated upon and treated two typical cases of mechanical obstruction. The histories are interesting and may be regarded as instructive, even in the absence of satisfactory results.

H. F. R., male; age 51; grocery merchant in Iowa. Came to Colorado seven years ago for asthma; bought ranch and engaged in cattle business; recovered early from asthma and was in good health until last fatal illness, which commenced August 15, 1913, at which time he took an active cathartic. The effect was severe griping pains in abdomen with satisfactory result. The next day, on account of pain, he sent for a physician, who proceeded to give cathartics which were vomited, rectal enemas which were of no avail, and hypodermatic injections of morphine to relieve pain. No other measures were used and the vomiting continued, finally becoming fæcal. On August 22 he was taken to St. Luke's Hospital in my charge. On admission his temperature was 97.4°; pulse, 92; he was restless, and only with great effort did he speak above a whisper. With a full week of vomiting and no nourishment his exhaustion was not surprising and yet his pulse was fair in volume and strength. There was not much tympanites or pain on pressure, but there was a globular tumor around the umbilicus. The abdomen was flat and dull below. Obstruction was manifest and I operated immediately. Subdermal salt solution was given on the operating table, and ether for anæsthesia. The operation revealed the upper small intestines lying in parallel rows and enormously distended, and the lower intestines collapsed. There was a volvulus of the jejunum with localized gangrene at the seat of obstruction. No general peritonitis, and adhesions were limited to the loop at the point of obstruction. There was no perforation and no free fluid in the peritoneal cavity. The intestines were easily withdrawn and the partially gangrenous loop incised but not divided, and a rubber tube put in each end and fixed by purse-

[2] Boston M. & S. J., 1911, ccxv, 684.
[3] J. Exp. Med., 1913, xvii, 286, and other publications.
[4] J. Am. M. Ass., 1911, lvii, 1338; and J. Am. M. Ass., 1914, lxiii, September 26.

[1] Read before the Western Surgical Association, Denver, December 18, 1914.

string suture. By gentle manipulation the intestines were evacuated and then irrigated, through the artificial opening, with warm salt solution, every care, of course, being used throughout the operation to prevent soiling of the peritoneal cavity. The intestine was stitched to the peritoneal incision and the gut protected by a wire screen over moist sterile gauze. Stomach lavage was used before the patient left the operating table; appendix, gall-bladder, and stomach were examined and presented no evidence of perforation or disease. Vomiting ceased immediately and his general condition was very good. August 23: 8:00 a.m., second day, temperature 98½° and pulse 94; 8:00 p.m., temperature 99½°, pulse 102, and respiration 20. August 24, same. August 25: 8:00 a.m., 98½°; 4:00 p.m., 101½°, pulse 116. August 26: same — morning and evening. August 27: 8:00 a.m., temperature 100½°, pulse 126. August 28: temperature 99° to 100½°, pulse 120 to 130; respiration 14. August 29: temperature 101°, pulse 120 to 130; intermittent and weak; respiration 8 to 26. August 30: temperature and pulse fluctuated in same way. Early on the morning of August 31, the patient died as one in profound exhaustion from starvation, and yet from the very day of operation, on the 22d, he was given and retained a large quantity of food by stomach and rectum, he was given salt solution daily, for hours, per rectum, and at intervals peptonoids by rectum, as well as by the artificial opening after irrigation of the intestinal loops. At the end of the second day there was free and frequent fæcal discharge per the enterostomy wound, requiring frequent change of dressing. He seemed to improve for three or four days, and then relapsed into the same restless, exhausted state, sleeping but little, yet free from pain, and with no complaint except weakness; no delirium and no mental confusion, but apathetic. No peritonitis developed, the abdomen remained flat and with no ordinary signs of sepsis. It is surprising that with complete obstruction he lived so long without relief and without nourishment.

The second case was a fine, intelligent boy, age 10 years, living with his parents on a farm near Stratton, Colorado. On September 2, 1914, while riding a bicycle alone in the country, his machine tumbled and he was thrown on his left side, bruising, but not cutting, the left epigastrium. He probably fell on the handle bar of his bicycle. He reported suffering severe pain, but after a little while started home pushing, not riding, his machine two miles. On the second day he was visited by Dr. Beachly, of Stratton, who recognized the surgical nature of his condition and brought him to St. Luke's Hospital, Denver, wiring me to be prepared to receive him. There had been no bowel movement, no escape of gas, and twenty-four hours after injury, rather frequent vomiting. Arrived at hospital September 5, with temperature 102°, pulse 116. The abdomen was considerably distended and painful on pressure. The stomach greatly distended and the patient vomited a great deal of liquid, bile-stained material. I operated immediately, making the incision to the outer side of the left rectus and extending the incision, as in the preceding case, above the level of the umbilicus. The moment the peritoneum was incised a large quantity of dark liquid blood escaped from the peritoneal cavity. Examination revealed a kink of the jejunum. There were no adhesions of consequence, and the obstruction was readily corrected; but deep in the belly, in the upper part of the jejunum, I discovered an abraded spot, at least an inch long, in the mesentery, with hæmorrhage beneath the adjoining peritoneal coat of the intestine for a distance of two or three inches. I closed the rent in the mesentery with catgut. There was undoubtedly a slow hæmorrhage from this spot with considerable effusion of serum. There was no other lesion in the abdomen. There was no gangrene and the color of intestines below the obstruction rapidly improved under hot cloths and salt solution. To stop the regurgitation into the stomach and to drain the upper loop of intestine, an immediate enterostomy was performed and the intestines irrigated with warm salt solution. For two days vomiting was frequent, necessitating frequent stomach lavage. It ceased at this stage and he took nourishment freely by stomach, with slow salt solution by rectum, with hypodermoclysis also. During the first two days he was, at times, quite delirious. The second day, September 6, the highest temperature was 101½°; evening 99½°; morning pulse 110. September 7, 8, and 9 temperature and pulse fluctuated in the same way. There was no delirium and the patient *seemed* better, although rapid emaciation was manifest in spite of the exhibition and retention of a large quantity of food by stomach, rectum, and small intestine through drainage tube. On September 10 and 11 the morning temperature was 100¼°, the evening 99° and 98½°, reversing the usual order. September 12: 6:00 a.m., temperature 98½°; evening 99¾°; pulse 116. The patient was weaker and again delirious by spells. September 13: temperature the same; pulse, 140; respiration, 20—never much accelerated. From this time on, exhaustion and emaciation were rapid, with same moderate temperature, but fast pulse, until his death on September 19, just two weeks from date of operation and twenty days from date of injury. The fæcal discharge around the intestinal tube soiled the wound, greatly inflamed the skin over the abdomen, and prevented union of the wound around the tube. This condition was doubtless due to the pancreatic secretions. This process was manifested on the fifth day after operation, and as vomiting had ceased, and he was retaining food by both stomach and rectum, I closed the intestinal stoma, under local anæsthesia, and applied sterile vaseline to skin of abdomen. He progressed very well for a day. There was no fæcal discharge by rectum, even with enemas. Vomiting recurred and I found it necessary to do a second enterostomy, which was performed at the upper angle of the wound under

local anæsthesia and above the previous intestinal opening. A large catheter was used for drainage and the intestines irrigated through it also. Vomiting ceased almost entirely. Nourishment was retained, but in spite of every care and attention, the little patient went on from bad to worse until the end, September 19. There was no general peritonitis, no distention of consequence, and no pain except from the irritation to the outer surface, due to pancreatic juices chiefly. No general sepsis existed.

In low obstruction the toxin, it is claimed, is not so virulent. In the experiments on dogs death occurred usually in three or four days, from complete obstruction. The treatment, so far, is in the main unsatisfactory because unsuccessful. In the condition of complete paralysis existing in these cases, after three days of complete obstruction, enterostomy seems a necessity, even with frequent stomach lavage. I used eserine and pituitrin to stimulate intestinal motility, but with unsatisfactory results. Vaccines made from the duodenal and jejunal mucosa of healthy animals have been suggested by Eppinger and Guttman for intestinal toxæmies on the theory of internal secretions of the intestines. Draper (Maury) found, from experiments, that dogs fed with such substances lived longer than the uncontrols. Hartwell and Hoguet admit that while the drainage from the tissues can be replaced by salt solution, it is not sufficient to prevent death. The solution was abundantly supplied in both my cases, and the kidneys acted well in both. Whether the tissue drainage into the distended intestine and stomach is primary and the toxin a secondary evolution, or vice versa, makes little or no difference with the treatment. We know that the former can be successfully met, but the toxin, the production and nature of which is not yet understood, destroys the patient very much as would be expected in a steady process of exhaustion from starvation.

Whether enterostomy should be performed in very recent cases brought promptly to operation for mechanical ileus with no serious intestinal lesion may be a debatable question. But after twenty-four hours, with intestines and blood-vessels distended and paralyzed, and vomiting frequent, there can be no doubt that enterostomy gives more prompt relief to symptoms, and at least prolongs life. Until some measure of relief is found for the toxin, the result of the obstruction, the mortality will continue high. It is to be hoped that by reporting such cases we may promote interest and inquiry in the solution of a grave and important class of cases.

GIANT-CELL TUMOR OF BONE

By F. GREGORY CONNELL, M.D., Oshkosh, Wisconsin

A STUDY of the giant-cell sarcomata of bone leads one directly into confusion, misunderstanding, and the use of words which apparently have different meanings to different people. The multiplicity of terms, such as medullary giant-cell sarcoma, myelogenous giant-cell sarcoma, myeloma, medullary giant-cell tumor, chronic (non-suppurative) hæmorrhagic osteomyelitis, that have been used to describe such lesions shows the indefiniteness of any one term. The distinction between these various tumors may be apparent theoretically; but clinically and microscopically it is not always present.

Adami (1) and Bland-Sutton (2) take these tumors away from the sarcomata and class them under a separate heading, the myelomata, which are described as tumors composed of tissue identical with that of normal red marrow of young bone. Bloodgood (3) realizing the disadvantage of the use of the term sarcoma, utilizes "tumor" as a substitute. Mallory (4) considers the giant cells merely an incident and would not use the term giant-cell sarcoma. Barrie (5) claims that this class of tumor formation is merely a type of inflammation and suggests the term chronic hæmorrhagic osteomyelitis.

That these tumors are usually benign, or comparatively non-malignant, was probably first recognized by Koenig; Bergmann, Bramann and Mikulicz, in 1895, were among the first to perform local or conservative operations for such conditions, and cases treated upon this principle have frequently been reported since that time.

The literature upon this subject may be found by referring to the writings of Bloodgood (6) who, in 1902, was the first in America to treat such a case conservatively, and who in a series of excellent monographs, and annually in the December number of *Progressive Medicine*, has repeatedly and strenuously advocated local operation instead of amputation.

The relative benignancy of giant-celled tumors of bone would seem to have been conclusively demonstrated, yet a malignant type of this tumor does occur, as is shown by the report of Coley (7), of the late J. C. Stewart (8), and others. Stewart claims that even one fatal case is enough to disprove all theories of benignancy, and he asks the very pertinent question, "What is a giant-cell sarcoma?" The usual answer is, a sarcoma which contains a large number of giant cells, just how many giant cells seems undetermined so long as they are enough to give a distinctive picture. Such an imperfect definition is of course unsatisfactory and gives rise to confusion. It was claimed by Stewart that the matrix in which the giant cells lie is the essential element in this tumor, and is responsible for its clinical features; others arrive at this same conclusion. Jones and Whitman (9) say that "benignancy or malignancy must be decided for each case, independently, and the diagnosis reached on grounds entirely separate from the presence or absence of endothelial giant cells."

Another explanation for the conflicting opinions was presented by Mallory (10) in 1911, in which he emphasizes the fact that there are two types of giant cells: a tumor giant cell and the other, a foreign body giant cell. (Fig. 1; see also Figs. 3 and 6.)

The former are usually large clear bladder-like cells, with distinct outline, but staining faintly, within which there are multiple nuclei, or a large multilobulated nucleus, with mitotic figures, which stain deeply and are situated in the center of the cell. These are usually not important features of the microscopic picture, although at times they may be numerous and conspicuous. They are true tumor-cells, result from multiple mitosis, and signify rapid growth.

The second type are, as a rule, smaller, with their cytoplasm fairly abundant, sharply defined, and staining deeply with acid dyes. The nuclei are smaller, uniform, more numerous without mitoses, and are often in clusters near the periphery of the cell. They resemble the osteoclast of the bone-marrow, and are not tumor-cells, but are merely a reaction to the presence of foreign bodies, and are due to the fusion of endothelial leucocytes. This form of origin has been well shown by Whitman (11). They may occur in any part of the body, in tuberculosis or other granulomata, myoma of the uterus, cancer, in simple reparative or regenerative processes. They differ in no respect from the osteoclasts that occur in connection with bone under normal and pathological conditions. Foreign body giant cells in a tumor involving bone usually signify only erosion and disintegration of bone. They may be present in either rapidly or slowly growing tumors, and do not signify rapid growth or malignancy. Both types may occur in the same specimen.

Mallory concludes that bone tumors should be classed according to their type cell, without reference to the presence or absence of giant cells, and that their malignancy should be determined by evidence of invasion of other tissue, their rapidity of growth, and by the number of mitotic figures present. According to Adami (12), who does not agree with Mallory regarding these giant cells, von Hansemann recognized three distinct forms of giant cells:

1. Foreign body giant cell of endothelial and leucocytic origin.

2. Parenchymatous giant cell, tumor-cell proper, due to irregular mitosis, and lack of cell-division.

3. Myeloplaxes. These are present normally in the red marrow of bone as osteoclasts, and are the characteristic constituent of the myelomata.

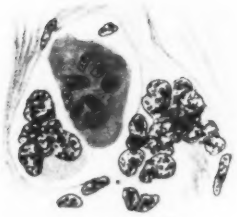

Fig. 1. Shows a foreign body giant cell between two tumor giant cells. *From Mallory.*

The last differs from the first in that the nuclei are distributed evenly through the cell-body, and by an absence of central degeneration of the body, and differs from the second by the nuclei being well formed and of uniform size.

As long ago as 1897, McCosh (13) stated that in the future this group of bone-tumors would have to be subdivided.

Trotter (14), in 1907, called attention to the necessity of a microscopic differentiation between the giant cells of bone-tumors. M. J. Stewart, of Leeds, England (15), urged the necessity of differentiating between the true "myeloid" sarcoma and the malignant giant-cell sarcoma, and suggested that the histological diagnosis should be based upon the morphological characteristics of the giant cells, especially as regards their nuclei, claiming that in myeloid sarcoma they were numerous, uniform, small, and without mitosis, while in the malignant type they were few, irregular, often very large, and mitotic figures were frequent.

The unsettled condition regarding this pathological condition is again emphasized by the case in which Coley (16) reports an ossifying myositis, which subsequently became malignant, was diagnosed as giant-cell sarcoma by Professor Ewing, and in which amputation was followed by metastasis and death. Bloodgood (17) discusses this case and in speaking of the photomicrograph of the tissue says it "does not look to me like a giant-cell sarcoma, but a very malignant mixed-cell sarcoma containing giant cells." Such circumstances would lead one to concur with Hertzler (18) when he says "it must be recognized that there are no positive microscopic signs of sarcoma; it becomes necessary to resort to other evidence than that of the microscope, such as the history and macroscopic appearance of the growth."

Fig. 2. A (lower right marked Fig. 10), from the tumors in the lung; B (upper right hand marked Fig. 8), from the secondary growth at shoulder; C (upper left hand marked Fig. 7), from the tumor removed at amputation. *From Cathcart.*

Bloodgood (19) says, "Every now and then .... I have been informed of a case of giant-cell sarcoma in which the patient died of metastasis. Some of these tumors I have been able to investigate and have found that the tumors were not giant-cell, but the most malignant sarcoma of the cellular type containing some giant cells, and that, when the metastatic tumors have been examined, there were no giant cells."

It is therefore interesting to refer to a case in Cathcart's work on *Innocent and Malignant Tumors* (20), under the heading of malignant myeloid tumors. Case 11 is summarized as follows: "Fibroplastic tumor of the humerus containing myeloid cells; amputation at the shoulder joint; recurrence of the disease; death three months after operation; secondary tumors in the lungs." The details of this case are given at length, but I shall quote only from that portion of the report that describes the tumors in the lung. He says that "the myeloid cells are not so numerous or as large as those in the larger tumor." Figure 2 is taken from Cathcart's

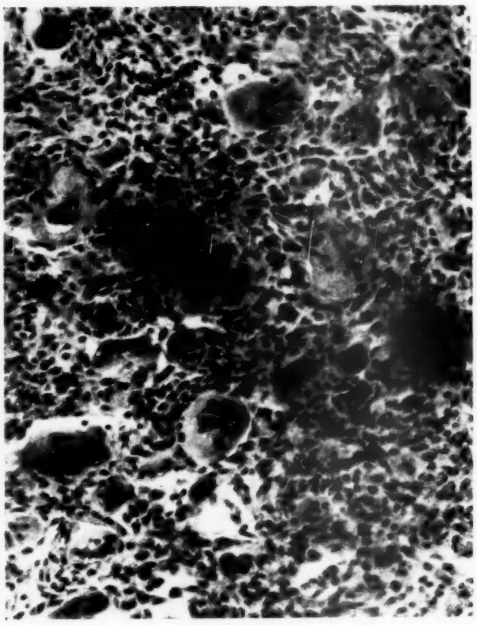

Fig. 3. Foreign body giant cells.[1]

Fig. 4. Case 2 before operation.

book. A, shows the myeloid cells in the lung; B, in the secondary growth in the shoulder; and C, from the tumor removed at amputation. The observations made upon this case by Mr. Mitchell Henry are doubly interesting when one considers the date upon which they were made; that is, October 20, 1858. With a change of some of the names mentioned, it might pass as a contemporary discussion on the subject. It once again shows the wisdom of the old saying, "There is nothing new under the sun," and the marvelous facility of history to repeat itself. The observations upon this case are, without doubt, worthy of quotation at length.

"The foregoing case is of great interest and importance from a surgical and pathological point of view, because it shows that the so-called myeloid tumor may run a course which cannot be distinguished from that of the most malignant cancer. The microscopic examination of the original tumor left no doubt as to the myeloid nature of the disease, and the surgeons present at the operation of amputation at the shoulder-joint expressed a confident opinion that the whole tumor had been removed together with the humerus to which it seemed to be exclusively confined. Notwithstanding this, in the course of eleven weeks a similar tumor grew from the scapula, and after the patient's death myeloid tumors were found in the lungs. The result of the case is disappointing to those who were inclined to accept the explanation that those quasi-malignant tumors of the extremities, in which amputation has formed a permanent cure, have in reality been examples of innocent kind of tumor, fittingly denominated 'myeloid.' Such tumors were first clearly described by Lebert, under the title of fibroplastic growths, and the characteristic myeloid cells were described and figured in his plates, although he does not seem to have been aware that the cells are similar in appearance to the polynucleated cells of the marrow and diploë of bones. The case just related, as well as the one detailed by Mr. Hutchinson in the last volume of the *Society's Transactions*, show that Mr. Henry Grey is in error in the conclusion to which he arrives in his paper on myeloid tumors in the *Medico-Chirurgical Transactions*, that they 'are not malignant and when entirely removed never return'; indeed two of the cases narrated by Mr. Paget in the chapter in his *Lectures on Surgical Pathology* in which he first proposes the employment of the term 'myeloid'

[1] The photomicrographs were kindly made by Professor C. H. Bunting of the University of Wisconsin. The slide of Case 1 was found to be not suitable for photographing, and additional tissue being unavailable Professor Bunting substituted a markedly similar slide having giant cells of the same character. This illustration is inserted as a contrast to Fig. 6 from Case 2, showing tumor giant cells.

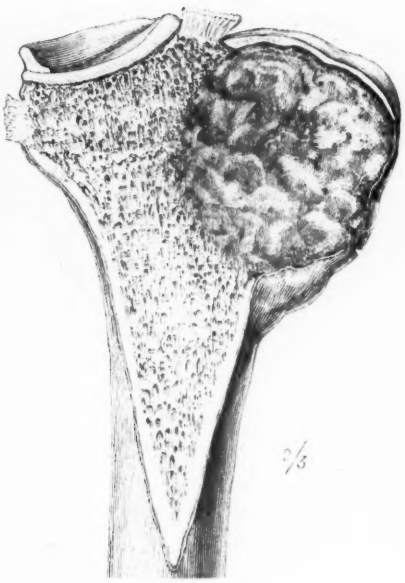

Fig. 5. Myeloma of head of tibia. *From Sutton.*

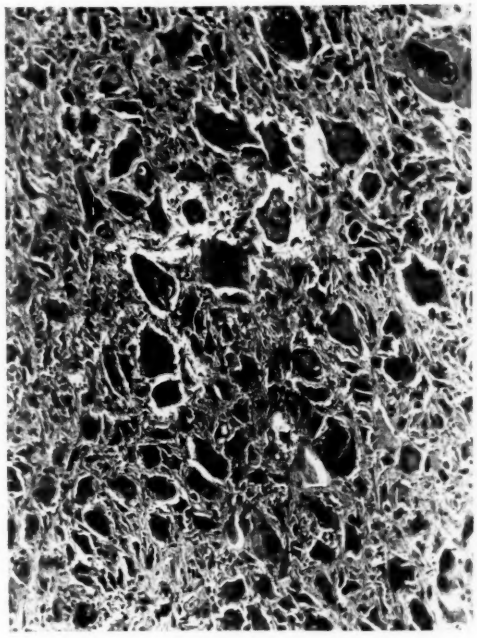

Fig. 6. Case 2, showing tumor giant cells. Compare with Fig. 3 (photomicrograph by Professor C. H. Bunting of the University of Wisconsin).

would have seemed, *a priori*, to have thrown considerable doubt upon Mr. Grey's statement.

"It is remarkable, however, that these myeloid cells should have been found in so many of the cases of amputation of limbs for supposed malignant disease, in which the operation is known to have been successful; but the question now arises whether they indicate anything more than that ossific changes are occurring in a tumor, in which case they will be found indifferently in malignant and in innocent growths. Subsequent experience may enable us to determine the exact import of myeloid cells, but at present it seems to me premature to elevate a characteristic which may, after all, be only accidental, into the test of a radical difference in the nature of a tumor."

Clinically these tumors are usually located at the ends of long bones, most frequently at the upper end of the tibia. According to Bland-Sutton, they occur in this bone five times more frequently than in any other bone, and five times more frequently at its upper than in its lower extremity. They are more common in young people, and the same authority says that they are rare after 25 years, though Bloodgood reports a case at 66 years.

The onset is usually sudden, after a more or less severe traumatism. Tenderness is constant, but pain as a rule is not marked until there is a definite swelling. The course of the process is usually slow and of long duration. There may be crackling on palpation, the so-called "ping-pong" bone. There is no redness or dilated blood-vessels over the swelling.

The X-ray picture is not characteristic, and the earlier the case the more difficult is the differentiation between bone cyst, ostitis fibrosa cystica, and even metastasis of carcinoma or hypernephroma. In giant-celled sarcoma the expansion is more abrupt and circumscribed, and the distention greater, than in bone cyst or ostitis fibrosa in which there is not so much expansion, the growth less localized, and more extensive longitudinally. In the benign growths, even with marked expansion, there is a preservation of bone-shell; while in the malignant medullary sarcoma the growth extends directly through the bone, without causing any marked

preliminary distention. The X-ray is only an aid to diagnosis and should not be depended upon by itself in making a diagnosis.

On section the tumor is usually confined within the periosteum, the overlying bone may be very thin, the growth is definitely circumscribed, not infiltrating, and is easily removed from the bone-shell. The tumor proper is distinctly vascular, resembles young granulation tissue, in which may be found whitish bodies varying in size from a pea to a grape seed, areas of osteitis fibrosa. The tissue in gross has been likened to red currant jelly, fresh cut liver, schmierkäse and red bar-de-luc. In consistency it is friable, soft, and oozes, may be gelatinous, and might resemble section of brain tissue at recent autopsy. The microscopic picture varies greatly, giant cells of the osteoclast type predominating. Without these the histologic picture suggests granulation tissue. There are many endothelial-lined blood-spaces separated by connective-tissue stroma filled with spindle and round cells.

As has been said above, the diagnosis of giant-cell sarcoma is to a certain extent a matter of personal equation of the pathologist, as men of recognized ability may differ in the interpretation of such tissue.

CASE 1. Miss B. G., schoolgirl.[1] In 1907 this patient was referred to the late C. W. Oviatt by Dr. H. W. Abraham of Appleton, because of a swelling of the upper jaw. The clinical picture was typical of tumor of the superior maxilla, the swelling was about the size of a baseball, with protrusion of the eyeball, and broadening of the nose, with egg-shell crackling on palpation. There was no evidence of disease of the mucous membrane of the mouth or of the alveolar process; there was no redness or œdema of the skin. There was no pain or tenderness: her only complaint was a sense of fullness and the unsightliness of the deformity.

Under general anæsthesia, the mucous membrane above the alveolar margin was incised, and the antrum was opened with a curette, and a spoonful of what appeared to be granulation tissue was removed for microscopic examination, and a piece of gauze was placed in the wound. Healing was prompt. The microscopic examination led to a diagnosis of giant-cell sarcoma, (the giant cells being exclusively of the foreign-body type), and excision of the superior maxilla was advised (Fig. 3).

[1] I am unable to give a detailed history of this case, but because of its rather unusual nature, the extent of time that it has been under observation, and a slide of the tissue being available, I have considered it worthy of a brief summary.

Operation was refused, and the patient has received no medical attention. The swelling gradually subsided and she has enjoyed good health ever since. A recent report from Dr. Abraham says that the swelling has practically disappeared, and that the patient is apparently in the best of health.

It is well known, of course, that giant-celled epulis is a most benign tumor and that recovery is to be expected after local or conservative treatment. However, this tumor was not an epulis, but a sarcoma of the antrum of Highmore, and the removal of a minute fragment for diagnosis would hardly be classed as even a local or conservative line of treatment. The case is of interest and value in emphasizing the reserve with which one should credit an occasional so-called cure following some more or less unusual line of treatment. The fact that spontaneous cure, or rather spontaneous subsidence of probable malignant growths, must be reckoned with is hereby emphasized.

That all cases of giant cell sarcoma do not terminate as the above is well shown by Case 2.

CASE 2. Mrs. M. O'D., Russian; married; housewife; has lived in America 19 months; was referred by Dr. W. J. Schmidt, of Mayville. Previous and personal histories negative; family history unknown. In October, 1913, patient first noticed a swelling, the size of a hazelnut, on the upper and inner aspect of the right tibia. There was complaint of swelling, redness, and tenderness, but no spontaneous pain. Treatment consisted of counter irritation, antirheumatic medicines, and later massage. The swelling increased and the pain became intense and constant so that in February, 1914, she could no longer walk, because of pain. A plaster cast was then applied to the knee, but with no improvement.

In May, 1914, the patient entered the hospital in the ambulance. The cast had been removed and the patient complained bitterly when the limb was moved. Examination revealed a thin, emaciated young woman, very apprehensive and crying out with pain on moving the limb or touching the swelling, which was about the size of an English walnut and raised about half an inch from the surrounding surface at its highest point. It was located at the internal anterior aspect of the right tibial head, was distinctly localized, the skin over the swelling was freely movable, with no redness, œdema, or dilated veins. There was no egg-shell crackling, or "ping-pong" bone.

The knee-joint was not swollen and appeared normal; active motion was not possible and passive motion caused severe pain. Because of the exquisite tenderness, the swelling was aspirated, but with

Fig. 7. Case 2, showing involvement of joint and femur.

Fig. 8. Case 2, longitudinal section of tumor after amputation. A, Granuloma removed at second operation.

negative results; temperature was normal, there was no leucocytosis, urine was negative, with Bence-Jones bodies absent.

X-ray picture, by Dr. C. H. Nims, showed a localized lobulated tumor in the head of the tibia (Fig. 4). Because of the marked similarity, I am reproducing a picture of a similar tumor from Bland-Sutton (Fig. 5).

On May 28, 1914, under ether, an elastic constrictor was applied and a longitudinal incision was made over the swelling. Division of the periosteum exposed the tumor which was distinctly localized and was composed of lobules of whitish gray cheesy material, with bony trabeculæ extending from the periphery toward the center.

This mass was easily removed with curette, and was about the size of a golf ball. There was no distinct membrane lining the cavity which extended upward to the cartilage of the joint, posteriorly to the periosteum, and downward to the normal marrow of the medullary canal. It was separated from the opposite side of the head of the bone by a distinct wall. The walls of this cavity were curetted and cauterized with carbolic acid and alcohol.

Frozen sections by Dr. Emily Oberlin revealed a typical giant-cell sarcoma, the giant cells entirely predominating the histological picture, the true tumor giant cells and foreign body giant cells both being present (Fig. 6). The remaining cavity in the head of the bone was filled with subcutaneous fatty tissue, derived from the patient, the wound closed without drainage, and a plaster cast applied to the entire limb, the cast was cut at once.

Convalescence was noteworthy because of the constant and pitiful complaint of pain in the limb. There was primary union and the stitches were removed and the cast changed on the seventh day. On the twelfth day the fat escaped as an oily discharge from a minute opening at the upper angle of the wound. There were no local or general manifestations of infection of the wound. This was not followed by any relief from the pain which was constantly complained of.

I anticipated that after the discharge of fat, the wound would close, and I went on my summer vacation and did not see the patient again until September 11, 1914. During the interval there had been an outgrowth of granulation tissue from the wound, which continually increased in size and was soon followed by swelling of the knee-joint; on July 9th an incision was made into the knee-joint, from which granulation tissue presented, which failed to close, and the granulating mass continually increased in size.

The patient was readmitted on September 11, 1914, with a granulating mass at the site of the previous incision and involving the knee-joint. This granuloma was about the size of an orange with a disintegrating crater in the center from which there came a very offensive discharge. The tissue seemed extremely sensitive and very vascular. There was no palpable enlargement of the iliac glands, and

cachexia was absent. The patient had become a morphine habitué, and amputation was absolutely refused.

Wassermann, by Dr. Oberlin, negative. X-ray examination, at this time, showed destruction of head of the tibia, with invasion of the femur (Fig. 7). On September 17, 1914, under ether, this granuloma was excised (Fig. 8-A).

The entire head of the tibia was involved and the resultant cavity was cauterized with the actual cautery and loosely packed with gauze, and a trough splint applied.

Sections of tissue removed at this time showed some areas quite similar to that removed at the primary operation, while other areas showed mixed-cell sarcoma with fewer giant cells, and small round-cell infiltration. There was no amelioration of the symptoms following the cauterization, and on October 10, 1914, the cauterization was repeated under ether, and it was then noted that the growth had extended into the popliteal space. This second cauterization was followed by no change in the course of the disease. In spite of the suppurating mass, and the constant pain, there was an absence of the usual so-called "cachexia" and no regional infection. Permission to amputate was finally given, and on October 19, 1914, an aperiosteal amputation at the junction of the upper and middle thirds of the femur was performed. Figure 8 shows a longitudinal section of the tumor mass. Sections of this femur showed the same giant-cell formation. Amputation was followed by instantaneous cessation of pain, primary union, most rapid convalescence and satisfactory immediate result.

CONCLUSIONS

1. A diagnosis of giant-cell sarcoma is not sufficient.

2. An attempt should be made to make a diagnosis, regardless of the presence or absence of giant cells.

3. The giant cells should be differentiated into either foreign body, or tumor, giant cells.

4. Foreign body, giant-cell tumors are more common and usually benign.

5. Tumor giant-cell growths are uncommon and less benign.

6. Giant cells have been found in pulmonary metastases.

7. The marked differences of opinion regarding these tumors may be due to a failure to differentiate between the giant cells.

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Note: Since completing tne above an important further contribution has been made by M. J. Stewart in Lancet, Lond., 1914, November 28.

I am indebted to Professor C. H. Bunting for his interest in these tissues.

X-RAY DIAGNOSIS IN GYNECOLOGY WITH THE AID OF INTRA-UTERINE COLLARGOL INJECTION

By I. C. RUBIN, M.D., New York

THE idea of employing the X-ray for diagnosis in gynecology is obvious in view of the multiple uses to which this agency is put in the other specialties. The diagnostic employment of the X-ray in gynecology has thus far, however, been very limited. Certain lesions of the bladder and the pelvic ureters can be definitely revealed by the X-ray with or without the aid of metallic solutions. In obstetrics, the röntgen ray has been employed to demonstrate deformities of the bones of the pelvis and to determine the position of the fœtus *in utero*. The writer knows instances where dermoid tumors in young individuals have been diagnosed by means of the X-ray.

USE AND LIMITATIONS OF THE HYSTEROSCOPE AND THE POSSIBILITY OF CATHETERIZATION OF THE TUBES

For some time attempts have been made to imitate the examination of the uterus by methods which were applicable to the bladder. The David hysteroscope represents perhaps the best example of an electric-lighted instrument for examining the cavity of the uterus. By this instrument it was hoped that catheterization of the fallopian tubes would become possible and thus obviate the necessity of an exploratory laparotomy. The purpose of such a catheterization was, of course, both diagnostic and therapeutic. Were it possible to catheterize the tubes we would probably be able to cure many cases of sterility. Without entering into the limitations of the hysteroscope we may nevertheless point out that obstructions, e.g., a large submucous myoma, may prevent the introduction of such an instrument.[1]

Catheterization of the tubes, however, can never be successfully carried out even if no uterine obstruction is encountered, for the following reasons: 1. The uterine ostium of the fallopian tube is exceedingly small by comparison with the mouth of the ureter within the bladder. 2. The probe or catheter would have to be of such delicate construction that its passage may prove dangerous from breakage or perforation. 3. The fallopian tube is wider as the abdominal end is reached and it is well known how difficult it is even by sight to pass a probe through the isthmic end, not to speak of the intramural portion of the tube lumen. 4. In doing this maneuver from within the abdominal cavity it is absolutely essential to steady the fimbriated end of the tube to enable the probe to pass through the lumen. An artificial passage is very easily made owing to the anatomical peculiarity of the endosalpingium. This takes place even under the guidance of the eye. Some other means must therefore be found to determine before operation the patency or non-patency of the fallopian tubes.

In dealing with cases of sterility particularly of long standing one is often puzzled regarding the condition of the tubes. The following is an example of such a case.

A. B., 36 years; married 15 years; no children, no miscarriages. As far as patient remembers she had no irregularity in her menses, which are of 4 to 5 days' duration and are not associated with pain. The patient had been seen by a practitioner who advised a curettage and dilatation and the introduction of a stem pessary. The advisability of a plastic operation on the cervix was also under consideration. On examination, the cervix was plump, the external os was elliptical. The sound entered easily in an anterior direction for a distance of three inches. There was no discharge; no gonococci were found in the smear from the cervical secretion. It was evident that nothing could be gained by the proposed operation. The tubes were not palpable. There was palpable enlargement of the ovaries. The semen contained active spermatozoa. From the history there was every assurance that the sexual act was complete. The data were incomplete in regard to only one point, namely, the tubes. Might not they be occluded at some point so as to block the transportation of the ovum of the uterus? Patient was candidly told that nothing could be done for her except to explore the tubes. She readily consented to the laparatomy which revealed both tubes normal in appearance, and patent.

[1] The value of collargol in this connection has been indicated in a preliminary communication. Zentralbl. f. Gynäk., 1914. April.

Fig. 1, Case 1.

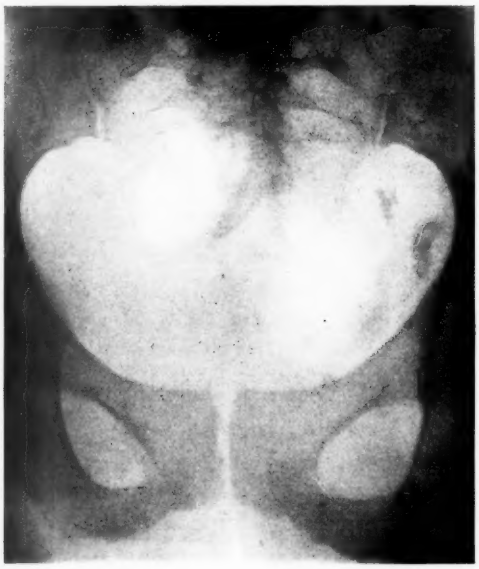


Fig. 2, Case 6.

Schematic drawing for Figs. 1, 2, and 3.

Fig. 1. Case 1. Sterility and small uterus. Note the pear-shaped cavity of the uterus and the normal narrowing of the uterine end of the tube. Note also the relative position of each tube. On the left side the tube is elevated owing to the presence on that side of a large intraligamentous cyst. a, small amount of collargol escaping from the left tube. s, syringe just above the internal os.

Fig. 2. Case 6. Patient age 32. Total amenorrhœa. First injection of collargol (5 per cent). Instruments removed. No shadow of uterus or tubes. There were found, however, shadows of phleboliths, or calcified glands, at a.

Fig. 3. Case 6. Second injection, about 2 ccm. of 10 per cent collargol used. X-ray exposure during injection. Note small irregular uterine shadow. a, irregular uterine shadow; b, phleboliths or calcareous glands; s, speculum and syringe *in situ*.

INJECTION OF COLLARGOL INTO THE UTERINE CAVITY AND FALLOPIAN TUBES

The operation led us no farther toward the solution of the problem of sterility in this instance. On the other hand we could not help feeling that there should be some way of determining the patency of the tubes without resorting to an exploratory laparotomy. Collargol naturally suggested itself in conjunction with the X-ray. Theoretically it was fraught with greater danger than when employed in pyelography, cystography, or as employed to determine the patency of the vas deferens and seminal vesicles. In all these instances the collargol is introduced into closed sacs.

Possible dangers. Injected into the uterine cavity and through the tubes the fluid might escape into the peritoneal cavity. In this way infective material might be carried into the peritoneal cavity and possibly lead to a peritonitis; while aseptic material similarly transported from the uterus and tubes into the peritoneal cavity might eventually stimulate an aseptic, adhesive localized peritonitis.

The first objection could be overcome by first selecting the cases; active infections of the uterus and tubes would obviously be contra-indications to the use of the test. In healed lesions of the tubes, in tubes closed off by external adhesions or by an internal agglutination of the endosalpingium, no harm could result from the injection. In instances of pyosalpinx or hydrosalpinx there would be practically no more danger from the injection than there results in pyelography. Of greater importance was the possibility of causing harm in non-infective cases. While the bactericidal properties of the collargol could be counted on to neutralize mildly infective material, the production of adhesions in the pelvis by virtue of a possible irritating action upon the peritoneum would prove an undesirable complication or sequel of the collargol injection.

Theoretically, too, it remained to be proved that the fluid would pass through the tubes in every instance of normal anatomical conditions. From reports in the literature, fluid has been known to pass through the tubes into the peritoneal cavity during irrigations in puerperal uteri and in uteri after abortion.

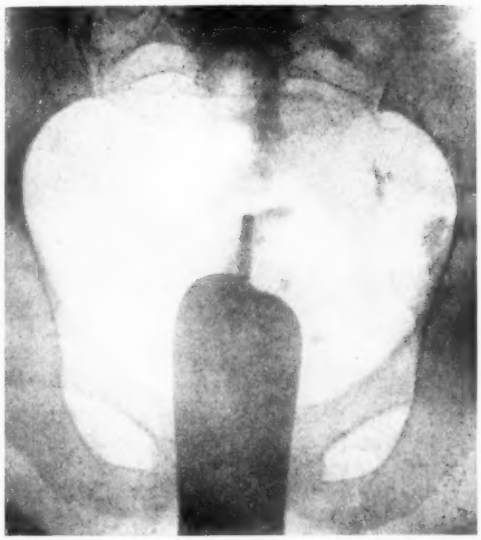


Fig. 3, Case 6.

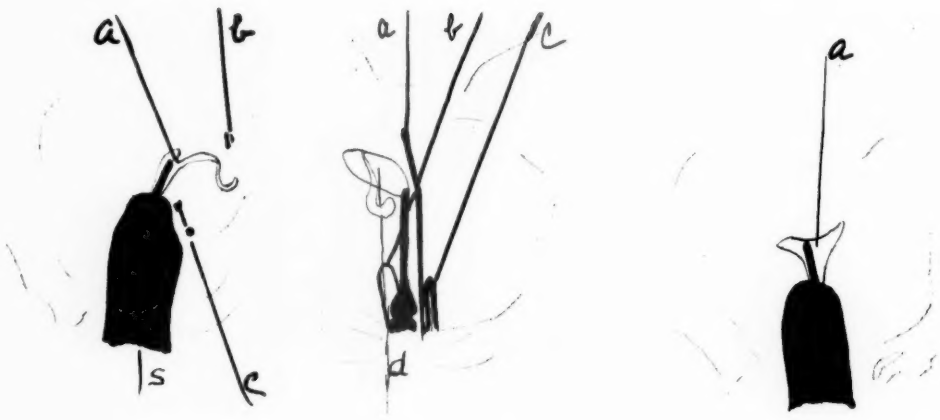
This has been regarded as accidental. The practice is nevertheless in vogue of irrigating as a routine measure after curettage. In gonorrhœal infections of the uterus and tubes iodine is often injected into the uterus in the hope that it will reach the tubes.

In order to prove that the method would be safe as well as practical it was essential to establish: 1. The non-toxicity of the fluid when injected into the peritoneal cavity. 2. The amount necessary for the test. 3. The maximum strength of the solution. 4. The non-irritating effect on the peritoneum.

Toxicity of collargol. From our knowledge of the action of collargol solution in the treatment of certain septic conditions it is apparent that the system tolerates collargol very well even when injected directly into the blood. Crédé originally employed it in 2 per cent strength and injected 40 to 60 ccm. into the blood-stream; later he recommended even a more concentrated solution, i.e., 5 per cent. The amount necessary to pass through both tubes into the peritoneal cavity in cases where there is no abnormal dilatation of the uterus or of the tubes was found to be 5 ccm. The injection of collargol in the strength of solution and in the quantity required for our

Fig. 4, Case 6.

Fig. 5, Case 7.



Schematic drawing for Figs. 4, 5, and 6.

Fig. 4. Case 6. Third injection, 5 ccm. of 10 per cent collargol. Only left tube revealed. s, speculum and syringe *in situ;* a, uterus and left tube; b and c, phleboliths or calcareous glands.

Fig. 5. Case 7. Double uterus and cervix with septate vagina. a, uterine sound as far as fundus of right uterus; b, tenaculum on left cervix; c, tenaculum on right cervix; d, left half of double uterus. Note its size and position in relation to the syringe. The tube is distended.

Fig. 6. Case 8. Bilateral salpingectomy two years previously. a, uterus, tubes absent.

purposes would therefore very probably never prove lethal.

To establish the safety of the intraperitoneal injection, 5 ccm. of collargol of a 15 per cent solution was introduced into the peritoneal cavity of two rabbits. The animals were unusually quiet and refused food for twenty-four hours; after that time they behaved normally. (Dr. J. Novak, who kindly observed the animals, reported that their condition subsequently was normal.) Since the amount injected in these rabbits did not prove toxic it is fair to assume that a smaller dose introduced into the uterus for diagnostic purposes should not be attended with toxic effects. It was further necessary to prove that collargol injected into the uterus will pass into the tubes and then into the peritoneal cavity.

Percentage of collargol necessary. The first studies made were on cadaver material of very old subjects. The solution used was 15 per cent to 20 per cent in strength. The shadows obtained were very dense. I found also that in certain instances the fluid did not go through the tubes. On investigation this was found to be due to an obliterative endosalpingitis not uncommon in senile individuals. The solution was also too thick to pass through these tubes because later the same tubes permitted the passage of an aqueous solution of methylene blue. I found also that a 5 per cent solution of the silver salt did go through when a 15 per cent or 20 per cent solution did not. When I tried the more concentrated solutions and found they did not pass through the tubes of the uteri I had at my disposal for the experiments, I conceived the idea of employing the injection of collargol into the uterine cavity for the purpose of diagnosing intra-uterine conditions especially in these cases where the introduction of a uteroscope was not feasible.[1] For such purpose the method can be used without any danger, as later observations proved.

The 10 per cent collargol solution gives satisfactory pictures, and for illuminating the tubes proves sufficient. A more concentrated solution is not likely to pass through while a 5 per cent collargol solution is not satisfactory. In a series of cases in which this percentage was tried the pictures were negative as far as collargol shadows were concerned.

[1] Zentralbl. f. Gynäk., 1914, April.

Fig. 6, Case 8.

Concerning the irritating effects on the peritoneum, I have injected collargol in eight cases in strengths varying between 5 and 10 per cent; one patient received three injections. The effects of a peritoneal irritation should in general be manifested by (1) pain, (2) tenderness and abdominal rigidity, (3) abdominal distention, (4) temperature elevation and increase of pulse rate, (5) gastric disturbance, (6) disability, (7) the development of an inflammatory exudate, and (8) disturbance in ensuing menstrual periods.

For the method to have a clinical value these conditions and symptoms, or at least the more serious ones, must be absent. My object was next to test the clinical application of the method in relation to possible untoward symptoms and sequelæ. It was also desirable to ascertain whether the injection itself would prove painful.

The cases reported in this article are from the gynecological service of Beth Israel Hospital. The following is the record of the first intra-uterine collargol injection.

CASE 1. Sterility; femoral hernia and small uterus. L. H., age 33; married 12 years; no

children, no pregnancies. In hospital July 2 to July 21. Last menstrual period, June 28. Gynecological examination: Elongated "conical" cervix, fairly small body of uterus, right adnexa not palpable. On left side of uterus and closely connected with it is a cystic mass about the size of a grapefruit; it has the same consistency as the tumor presented at the right femoral region but is slightly larger. Collargol (10 per cent injection) July 7 (see Fig. 1); was followed by no pain whatever; next day femoral hernia (large properitoneal cyst) operated. First two days temperature was 100°, then normal throughout her stay at the hospital. There was no change in pulse rate, no abdominal discomfort. She was out of bed the twelfth day after operation and left the hospital July 21. She was X-rayed a second time nine days after the first injection; the plate this time was entirely negative, proving the disappearance of the collargol. Altogether 3 ccm. were injected. About 1½ ccm. were withdrawn immediately after the skiagraphy.

The patient was seen at my office August 20, i.e., six weeks after the injection. She had a menstrual period twelve days ago at normal time and has had no discomfort. She had menstruated immediately after the injection while still in the hospital.

Encouraged by the complete success of the first case we proceeded to try the method in conditions which were definitely known to be pathological. Instead of 10 per cent collargol we used a 5 per cent solution.

CASE 2. Double diseased adnexa. E. V. Disch. No. 1,860; age 23; married 2 years; had been operated before for pelvic trouble. In hospital June 29 to July 14, 1914. Operation: Removal cystic and suppurative ovary and chronic appendicitis. Freeing of completely embedded left ovary. No postoperative rise of temperature or increase in pulse. Collargol injection (5 per cent) 9 days after operation. No pain, no discomfort, no rise in temperature, no increased pulse rate. Faint outline of uterus, tubes not showing at all. Patient reports that August 12 she had her menses.

CASE 3. Ovarian cyst and incomplete abortion (suspected ectopic pregnancy). T. A., No. 1,861. In hospital June 29 to July 14. Operated June 30. Removed left tube and ovary and curetted uterus. Temperature rose to 101° for two days, then became normal. Collargol (5 per cent) injection July 6; no pain or discomfort experienced during or after the injection. Temperature at time of injection 100°; then rose for two days to 102°, then became normal. Pulse was 90; no discomfort or pain. Patient was discharged eight days later. When seen at my office August 25, she had had regular menstrual period without pain. X-ray negative.

CASE 4. Fibroid uterus (small intramural nodules). Collargol injection; laparotomy and hysterectomy. S. E., No. 2,647. In hospital July 7 to August 8. Age 35 years; married 15 years; 6 children; metrorrhagia 3 years; occasionally dysmenorrhœa. Uterus somewhat enlarged—very hard. Patient had had curettage without benefit. July 9. Injection 5 per cent collargol (5 ccm). Patient immediately complained of pain. This was described as similar to pain with her menstrual periods. Operation July 10. The pelvic peritoneum, sigmoid, and one loop of small intestine were stained black; the lower third of the omentum was similarly stained. There was nowhere, however, any evidences of congestion, exudation, or adhesions. The tubes were rather long. The uterus and both tubes were removed. The abdomen was closed without drainage. Temperature rose to 100.4° next day and remained at about this point for three days, then fell to normal. A rise of temperature three days later was due to an infected hæmatoma of the abdominal wound. It was worthy of note that there were no symptoms referable to intra-abdominal trouble. The X-ray picture was negative.

CASE 5. Sterility; small uterus, subacute salpingitis. B. T., No. 1,915. In hospital July 13 to July 21, 1914. Age 28; married 6 years. Last menstrual period, 4 weeks ago. Menses very painful; uterus very small; left tube thickened and tender. Temperature on admission, 100.4°. Collargol (5 per cent) injection July 14, 1914; about 5 ccm. used. Patient had severe abdominal pain and several attacks of vomiting during the next twenty-four hours. The abdomen was held rigid. The bowels were moved by enemata. Patient was placed in Fowler's position. July 16, the patient was more comfortable. She still had a coated tongue. Her temperature was 100° first day after the injection, 101° the next day, then 100°, after which it fell to normal. Her regular menses set in on July 16. The pulse was not above 104. The X-ray plate was negative. July 21, a second X-ray proved negative. August 25, the patient was seen at the office and stated that she had had menses two weeks ago; left tube palpable; sensitive to examination.

CASE 6. Total amenorrhœa (healed abdominal tb.c.?). C. L., No. 2,265. In hospital September 2 to September 10. Age 32; married 12 years; never menstruated. She had typhoid at 13 years, measles at 17, and fractured left thigh four years ago. Uterus small; cervix small; sound cannot enter cervical canal at external os. Finer probe enters to above internal os, then forced into the uterine cavity. Later, sound introduced into uterus reveals a rather small narrow cavity about two and one-fourth inches from external os to fundus. Collargol (5 per cent) injection August 26, unaccompanied by pain. Patient sent home same afternoon. The plate (Fig. 2) showed no evidence of collargol but some caterpillar shadows corresponding to about the region of the hypogastric and iliac lymph-nodes. Collargol injection (10 per cent used) August 29. The exposure was taken simultaneously with the injection. About 2 ccm. of collargol solution was introduced. The uterine cavity was irregularly outlined; the tubes not showing (Fig. 3). Same caterpillar

shadows as before. Collargol injection (10 per cent used) September 2. About 5 ccm. injected under pressure. Patient immediately complained of pain and vomited twice. The picture (Fig. 4) is practically that of Fig. 3 showing, however, more collargol in the uterus. The left tube alone is outlined. The end of the tube approximates those caterpillar shadows as seen in Figs. 2 and 3. The temperature rose to 102°, fell next day to 100°, and then to normal the following day. The pulse was never higher than 90. She was discharged four days later. When seen at the office there was no swelling in pelvis—no evidence of a local peritonitis.

CASE 7. Double uterus and cervix cum vagina septa. D. C., No. 2,270. Age 22; married 7 months. In hospital September 8 to September 12. (Patient referred by Dr. A. Granet.) Menses began at 13 years, of eight days' duration, extremely painful especially two days before onset. Past two menstrual periods were associated with agonizing pain. Coitus was difficult till partial excision by Dr. Granet of the vaginal septum. On examination, broad septum (anteroposterior) screens left cervix. This when exposed to view appears fairly plump. Sound enters the cervical canal for a distance of about one and one-fourth inches, then meets with obstruction. This overcome, sound enters a wide uterine cavity to extent of three and one-fourth inches. The right cervix is completely hidden from view; when pulled out with tenaculum it appears about one-half as large as that of the left uterus. Into this uterine cavity the sound enters two and one-half inches. In each instance the introduction of the sound was followed by the escape of dark blood; especially was this evident from the left uterus. The left uterus by palpation was also considerably larger than the right. Collargol 10 per cent injection into the left uterus, September 11, 1914. A sound was at the same time introduced into the right uterus as far as the fundus while a bullet forceps marked the external os (Fig. 5). The left uterus is shown considerably distended and lemon-shaped. The outline of a somewhat distended tube shows also (possible hæmatosalpinx). No rise in temperature or increase in pulse rate, but pain followed the injection for two hours, after which there was no further discomfort.

CASE 8. Absence of tubes (post-operative). Patient had double salpingectomy two years previously; had menstruated once two months after operation but never again. Collargol (10 per cent) injection September 11, 1914. No pain at injection; the patient had not been prepared as for a skiagraphy. The plate shows a triangular shadow (Fig. 6) corresponding to the uterine cavity tapering off at about the horns; the tubes do not show. Patient went home immediately after the skiagraphy and was seen three days later at the office; there was no mass or any evidence of trouble.

TECHNIQUE

The patient is placed on her back on the X-ray table; her knees flexed and separated. The use of the bivalve speculum saves the need of an assistant; it is therefore preferable. The cervix is exposed, cleaned, and then painted with iodine. The superior aspect of the anterior cervical lip is grasped with a tenaculum. A sound is introduced to get an idea of the direction of the uterine cavity and of its approximate size. The syringe used is a modified Braun intra-uterine sound with a Record barrel. It should be tried first and should work smoothly. The syringe should contain 5 ccm. of collargol solution (10 per cent).[1] The intra-uterine nozzle is introduced to just above the internal os. The X-ray plate is then put under the sacral region of the patient. The X-ray operator should be ready when the injection is to be made. The injection should be made without undue pressure —3 mm. mercury is all that is required. When the sound does not fit closely into the cervical canal, I have added the elastic conical rubber urethral point which may be fitted into the external os. When the fluid is observed to flow outside of the uterus it is well to stop. The excess should be wiped away. The speculum is partly withdrawn so as not to overlap the collargol shadow, and the X-ray is then taken.

After the X-ray exposure an attempt should be made to recover by suction the fluid within the uterus. Often more than half is recovered. The remainder is for the most part discharged within the next twenty-four hours. Should there be pain, it is advisable to stop the injection. Pain usually denotes distention of uterus or tube or escape into the peritoneal cavity. In either event it is an indication that sufficient fluid has been injected for diagnosis. When in doubt as to the presence of an infective process in the uterus or tubes the patient should be kept quiet for a day or two and observed. When there has been no pain there is no objection to permitting the patient to go home.

SUMMARY

While these cases do not represent the great variety of gynecological conditions in which the X-ray may be used in conjunction with

[1] The collargol solutions used were kindly prepared by Miss S. E. Dorfman, pharmacist to the hospital. Special care was given the preparation of the solutions to insure absolute asepsis.

collargol, they are sufficient to permit of certain conclusions regarding the value of that method in gynecology. The first case in which the method was tried left nothing to be desired. The injection was not painful, the picture was clear, and the course after injection was unattended by any ill effects. The X-ray picture served incidentally to *differentiate an extra-uterine tumor from an intra-uterine tumor* which the ordinary physical method of diagnosis had failed to do. This first case proved so satisfying to all demands made of the method that it bade fair to be a valuable additional means of physical diagnosis in gynecology. The temptation to publish this first case was offset, however, by the possibility that this may have been an ideal case for the test. It was necessary as well to establish contra-indications and, further, to control the success of the method. It was next endeavored to try a weaker solution of collargol with the view of diminishing the danger from the silver salt as much as possible. Accordingly in the next few instances a 5 per cent solution was employed. With this weaker solution we risked injecting a larger quantity than used in the first case. The cases in order were: (1) Double diseased adnexa, (2) ovarian cyst with incomplete abortion, (3) fibroid uterus, (4) small uterus (sterility) with subacute salpingitis, and (5) a case of total amenorrhœa in a woman 32 years of age and married 12 years. In this series of cases we learned that with the tubes occluded as in Case 1 (post-operative), the injection of collargol solution was absolutely safe; that with the tubes patent the fluid may and does pass into the peritoneal cavity without, however, causing an appreciable peritoneal irritation. The omentum[1] in such instance serves to take up the collargol as it would behave in the presence of some other foreign substance as lamp-black, etc. The post-operative recovery in these cases was satisfactory. We also found that in the presence of an infected tube which is patent there may be symptoms and signs of a peritoneal irritation, as in Case 4. The effects pass over in thirty-six to forty-eight hours without the necessity of operative interference, and no further ill effects are noted. Also that in the presence of an incomplete abortion or a febrile post-abortive endometritis a rise in temperature may be noted as in Case 2. There was no peritoneal irritation, however.

In none of these cases was the menstrual cycle disturbed. They all reported the onset of the next period at the regular time.

In Case 5 of total amenorrhœa the patient received two intra-uterine injections on two different occasions and each time she was permitted to go home immediately after the injection. She had no pain or discomfort.

The X-ray pictures in those instances where 5 per cent collargol solution was used were not satisfactory, indicating that a stronger solution was necessary. We then reverted to 10 per cent collargol solution, which gave satisfactory pictures.

Case 5, that of total amenorrhœa, who had had two previous injections then received 5 ccm. of 10 per cent collargol solution. The fluid was injected under considerable pressure as it was thought the tubes were closed. This injection was attended by colic and vomiting. Pelvic pain lasted a few hours. There were no manifest symptoms of peritoneal irritation. There was no doubt, however, that the forcible injection caused the colic. The quantity employed was too much, some of the fluid probably being forced into the parenchyma of the uterus if not causing pain by distention of the left tube.

I had previously demonstrated that with the tubes closed, it is possible to distend an extirpated uterus. In the living when this obtains it is most probably attended with violent colic. The 10 per cent collargol solution was further employed in "illuminating" the left uterus of an asymmetrical double uterus and in one case to show the uterine cavity in a patient who had had a bilateral salpingo-oöphorectomy two and one-half years ago. This patient was permitted to go home immediately after the injection. X-ray picture taken one week after injection failed to reveal any deposits or masses of collargol. From these cases it may be deduced —

1. That a 10 per cent collargol solution is essential for a satisfactory X-ray picture.

[1]The great omentum: an experimental and pathological study; I. C. Rubin. Surg., Gynec. & Obst., 1911, xxii, 117.

2. That under mild pressure (i.e., about 3 mm. of mercury) the injection is not attended by pain.

3. That it is desirable not to inject more than 5 ccm. of the solution in the average case, especially in cases of sterility with so-called infantile uterus.

4. That the cases should be selected. One should make sure there is no active infection of the uterus or the tubes. Post-abortive conditions with fever are contra-indications.

5. That the method is safe as far as peritonitis is concerned even in these cases and in properly selected cases should be absolutely safe.

6. That there are no bad sequelæ; i.e., no gross pelvic adhesions or exudates, as determined by bimanual palpation, have been found subsequent to the collargol injection.

7. That the menstrual cycle is not disturbed.

8. That the method is of aid (a) in the diagnosis of the patency or the occlusion of the tubes: (b) in differentiating intra-uterine from extra-uterine tumors as intraligamentous cyst from myoma; (c) in certain malformations of the uterus and possibly also of the tubes; (d) in determining whether a single or bilateral salpingectomy had been done on a patient that had previously been operated; (e) in studying true flexions of the uterus and maldevelopments.

HÆMANGIO-ENDOTHELIO-BLASTOMA OF THE STOMACH[1]

By J. GARLAND SHERRILL, M.D., and F. S. GRAVES, M.D., Louisville, Kentucky

TUMORS of the stomach are not common. A hæmangioma of the stomach is exceedingly rare. The report of this case is of interest and seems justified by the fact that very few similar cases have ever been placed on record. The clinical aspect of the case is submitted by Dr. Sherrill and the pathological findings are presented by Dr. Graves.

Mrs.——, white, age 31, came to me in the fall of 1907. Family history negative, with the exception of one sister upon whom I had just operated for carcinoma of the cervix uteri. The patient's husband had acquired syphilis prior to his marriage, but had taken vigorous treatment for three years and was apparently in good health.

Personal history. She was the mother of one child and had had two miscarriages. Some time prior to consulting me she fell, striking her epigastrium against the corner of a table. Soon after this she began to complain of loss of appetite, nausea, symptoms of indigestion and epigastric discomfort. These attacks occurred more frequently at night, and during the attacks she would regurgitate her food and there were eructations of salty stuff. Once or twice she vomited blood. She had more or less constant pain in the abdomen which was sometimes relieved by eating. Oftentimes she could not go to sleep at night until she had taken a cracker and some milk. She developed marked anæmia, lost flesh, and presented a peculiar cachexia.

When examined at this time she was tender over the region of the stomach and a palpable thickening could be felt in the epigastrium. The mass moved up and down with respiration. At times it could not be felt. The blood examination at this time was negative to malaria, 3,500,000 red cells; 7,000 leucocytes, no differential count being made; hæmoglobin 30 per cent. She was given a test meal, but the stomach was empty thirty minutes afterward; therefore the examination was not satisfactory.

A diagnosis of gastric ulcer was made and the patient was sent to the hospital with a view to bringing her into condition for operation if relief did not follow treatment. Rest in bed, carefully selected diet, and treatment of the ulcer brought prompt improvement. Subsequently this improvement seemed to be hastened by antisyphilitic treatment.

She came under observation once or twice during the next five years, but was at no time under my constant supervision. Her condition remained fair, but the mass persisted, sometimes palpable, sometimes not, always following the respiratory movements and also quite freely movable. When she consulted me October 4, 1914, the mass had reached almost the size of a kidney and had the wide range of mobility seen in floating kidney. This was so marked that there was some doubt expressed as to the attachment of the growth. It was so readily pushed into the right loin that a strong suspicion of movable right kidney existed. At times it was carried almost, but not quite, as far to the left side as to the right. Careful examination of the right kidney, however, enabled us to feel this organ normally placed. Over the growth slight dullness was elicited on percussion, while tympany was

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 16, 1914.

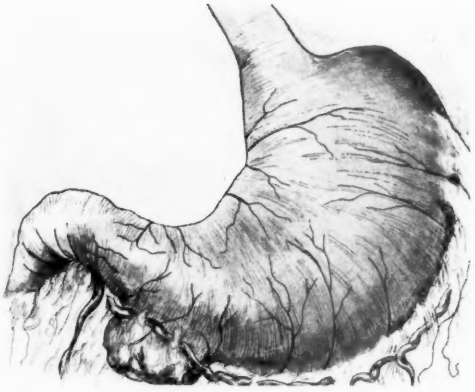


Fig. 1. Hæmangio-endothelio-blastoma growing over gastric ulcer.

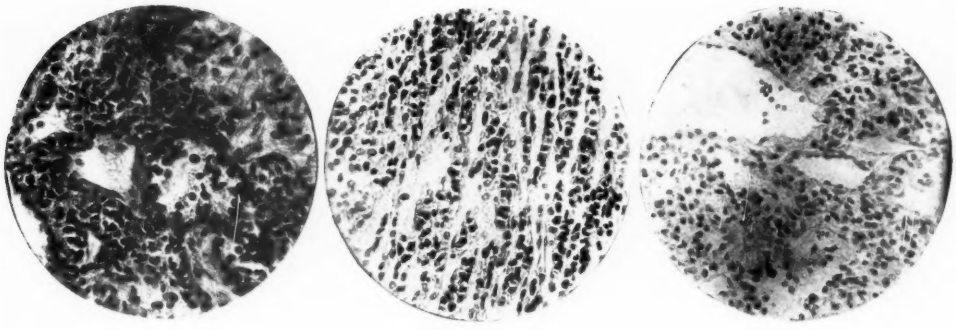
obtained both above and below. Her digestive disturbance when she last presented was not marked, consisting of soreness in the epigastrium, with some eructations and a sensation of fullness. Her husband informed me that about two years ago she had an attack at night. At this time she felt weak, she yawned, her vision was impaired, and she had a slow feeble pulse. He took these symptoms to be the signs of internal hæmorrhage. Within thirty-six hours the stools were black and blood was detected in them. Her anæmia improved at times and then recurred. The lump in the abdomen seemed to enlarge and was more tender at her menstrual periods. A Wassermann test was negative. Blood examination: hæmoglobin 50 per cent, red cells 4,500,000; leucocytes 6,000; large lymphocytes 8 per cent, small 16 per cent; polymorphonuclear leucocytes, 72 per cent; eosinophile 3 per cent, and myelocytes 1 per cent.

Diagnosis. Gastric ulcer with a growth, probably a tumor, although the possibility of a floating kidney was considered.

On opening the abdomen on October 5, 1914, a reniform mass growing from the greater curvature of the stomach near the pylorus and covered by the greater omentum presented to view. This mass was mottled purplish in color and had a rather broad attachment to the stomach. It moved freely with that organ, having no other attachments. A small glandular enlargement was found in the omentum near the base of the tumor. A portion of the stomach about four inches in length along the convex border and two and one-half inches along the concave border was removed, together with the mass and a portion of the upper part of the duodenum including the pylorus, and

Fig. 2. X-ray taken after operation, ten minutes after barium meal.

Fig. 3. X-ray taken after operation, twenty minutes after barium meal.



Figs. 4, 5, and 6. Sections from hæmangio-endothelio-blastoma.

the gastroduodenostomy was completed in the usual manner. It was smooth on the surface, somewhat firm near its attachment to the stomach, without induration, and soft in consistency along its distal portion.

Upon examining the growth after its removal, three small openings in the mucous membrane were noted, one of which extended entirely through the gastric wall and communicated directly with the inside of the growth. Through this opening the little finger could readily be passed. The center of the growth seemed to be broken down but contained only delicate tissue and no appreciable fluid. It has not been my experience to find a condition of this kind existing with gastric ulcer. I have on several occasions found the adjacent stomach wall markedly thickened and indurated, the induration even extending as far as the liver in one case, but I have never found a distinct tumor growing out from the stomach wall with its attachment at the site of an ulcer. There was a strong suspicion that this might prove to be a syphilitic growth, but this was disproved by pathologic examination.

A feature of great interest in connection with the case is the relation between the injury suffered by the patient and the development both of the ulcer and of the tumor. Traumatism has been known to play a very important rôle in the development of gastric ulcer, especially those that have been produced experimentally. Traumatism is also a known factor in the development of certain forms of neoplasm. Unfortunately, it is not possible to state positively whether the growth preceded the ulcer or developed subsequently. From the history I believe the ulcer occurred first; certainly it was present before the patient came under my care.

Another rather interesting feature in connection with the case is the length of time that this condition existed, and it perhaps would have some bearing upon the prognosis. We would scarcely expect a malignant growth to last for six or seven years without having advanced to greater size, and this would lead us to the conclusion that the growth was of a benign nature, which agrees with the view expressed by Mallory.

Fig. 7. Hæmangioma of stomach, tumor to left showing line of attachment of stomach.

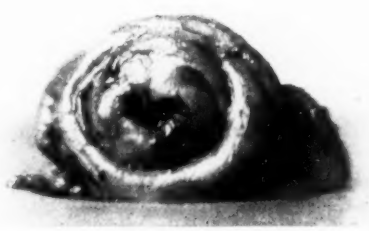


Fig. 8. Stomach everted, showing site of ulcers.

Since the operation the patient has improved and states that she feels wonderfully relieved, and eats everything without inconvenience. She is improving in color and there has been some increase in weight. An X-ray examination shows barium passed out of the stomach in the usual time. There is slight but not material irregularity at the line of suture, which could scarcely be made out in the skiagram.

The pathological report by Dr. Graves is as follows:

The specimen consists of the pylorus with adjacent portions of the stomach and duodenum, the piece of gastro-intestinal tract measuring 10 cm. in greatest length. In the mucous membrane of the stomach, about 2 cm. from the pylorus, are three small holes, the largest 2x5 mm., with sloping sides and slightly thickened edges. This lies directly over a mass, ovoidal in form, 7 cm. in greatest diameter, soft, covered with a glistening serous membrane with one adhesion between the tumor mass and the external surface of the gut. The mass varies in color from pinkish gray to dark purple in spots. On section cut surface is moist, glistening, soft, homogeneous and, in the two-thirds adjacent to the gut, is pinkish gray with scattered spots of very dark red. The farther one-third is uneven, broken down and dark red.

Microscopical description: Different sections show that the tumor consists chiefly of more or less spindle-shaped cells with round or oval, rather faintly staining nuclei. Their cytoplasm is nongranular and they do not have fibroglia fibrils. The cells in places are closely packed in masses. In other places they are arranged in strands or concentric whorling bundles separated by fibrous stroma. In some regions the tumor cells surround spaces containing erythrocytes. These lining cells are one or more layers thick and in them an occasional mitosis is seen. Some of these vascular spaces are fairly large, but most are small. This picture is varied by areas in which lumina containing erythrocytes occupy the greater portion of the field and are separated only by single strands of endothelial cells. A few of the vascular spaces are extensive, although lined with only a single layer of flat cells. The tumor is sharply circumscribed and is surmounted by gastric mucous membrane.

Diagnosis. Hemangio-endothelio-blastoma.

Mallory, in *The Principles of Pathologic Histology*, p. 370, on this subject says: "They are often congenital and frequently, perhaps always, arise from abnormalities of the blood-vessels, especially from vascular nævi. They occur most often in the skin and subcutaneous tissue, but may originate also in muscles, nerves, the liver, spleen, brain, bone-marrow, etc. They are to be regarded on the whole as benign growths, although locally destructive because their manner of extension is by infiltration of surrounding tissues and by growths within and along blood-vessels. Apparently but one case of metastasis is on record."

The following reports have been found in the literature:

Robert T. Morris,[1] in a report upon "The Effect of X-ray Treatment in a Case of Endothelioma of the Stomach," says that some months ago he did a posterior gastro-enterostomy to relieve pyloric obstruction in a case of supposed epithelioma. The growth was so extensive in character that a radical operation was deemed inadvisable, but a section was removed and submitted to Dr. Aspinwall Judd, who pronounced it an endothelioma. Under X-ray treatment, the growth had apparently disappeared entirely; the patient had gained about fifty pounds in weight and is now practically well, but may have a recurrence. Epitheliomata and endotheliomata, Dr. Morris says, simulate each other so closely that they are not to be distinguished except by the aid of the microscope, and if of the latter type the growth was amenable to the X-ray treatment, it was a fact worth keeping in mind.

In an article published[2] in the *Riforma Medica*, July 1, 1905, on "Endothelioma of the Stomach Situated near the Pylorus," Cignozzi summarizes the clinical features of endothelioma of the pyloric end of the stomach as follows: "The disease as a rule pursues a chronic course (six years in Brissaud's case, and ten years in Oettinger's case). The symptoms of stenosis develop gradually until the clinical picture of pyloric obstruction (vomiting of food) without previous hæmatemesis of melæna, comes into view. A smooth pyloric tumor which is movable and does not produce any metastasis nor any emaciation, such as occurs in cancer, is also characteristic of these tumors. Accurate diagnosis can only be made on the operating table."

[1] Med. Rec., 1910, April 16, 683.
[2] Abstracted in the N. Y. M. J., 1910, August 26, 452.

END-TO-END ANASTOMOSIS OF THE AXILLARY ARTERY

With Report of a Case

By E. OWSLEY GRANT, M.D., Louisville, Kentucky

THE infrequency of the reports of cases of end-to-end anastomosis of the axillary artery for bullet wounds is one of the principal reasons for putting this case on record. In its consideration, however, several factors have appeared on which I can find no previous literature but hope that some sufficient explanation will be forthcoming. Since Murphy reported the first successful suture of the axillary artery, end-to-end by the invagination process in 1897, there have been several attempts and some successes, but as these cases of complete severance occur only rarely, the literature is not so replete as might be expected. The case is as follows:

G. W. V. shot himself with a .32 caliber revolver, with suicidal intent, on May 26, 1914. The bullet entered the left side of the chest one and one-half inches outside of the left nipple line and emerged from the back five inches external to the second dorsal vertebra. He was seen by a physician and sent to the hospital. The hæmorrhage was not profuse, though there was considerable swelling in the left axilla. The radial artery on that side (the left) was not palpable; the pulse on the right was full and strong. The mental condition of the patient was clear; the left hand was cold and there was no sensation in it. No pulmonary symptoms intervened and a diagnosis of rupture of the left axillary artery was made. The patient was brought to the operating room within an hour after the injury and the following operation performed.

Operation. An incision was made in the axilla and several large blood-clots expressed. No bleeding point showed itself. Deeper dissection revealed the distal portion of the axillary artery, but no pulsation was discernible in it. Careful palpation revealed the proximal stump of the axillary artery buried in a clot and beating rhythmically. The proximal end was buried far in the axilla, and the point of severance was in the first portion of the axillary artery. The axillary vein was then examined and found to be intact. The nerves of the brachial plexus were not visibly injured. Clamps covered with rubber were then put on the two ends of the artery, and the clot, which extended for a distance of a quarter of an inch, was milked out of the proximal end of the artery. With this clot was expressed an entire circular portion of the artery one-eighth inch in length which was apparently the portion that had been shot away. Immediately after the clot was expressed there was a free gush of blood from the artery, but the bleeding was promptly controlled by rubber-covered clamps. The distal portion of the artery tended to bleed but little, though it had no visible clot in it, and it would have perhaps have been better if the rubber-covered clamps had not been applied at all as after-results showed. The somewhat ragged edges of the wound were now trimmed away as parsimoniously as possible and the edges approximated by exerting traction on the adventitia at some distance from the site of the anastomosis. The edges were approximated by the Carrel method with the overhand stitch. The needles used were Kirby No. 16 sharps, and the thread No. 000 China silk split into its component threads and treated with vaseline. The clamps were removed and no hæmorrhage occurred. Pulsation was palpable for an inch and one-half below the point of the anastomosis and here a large branch came off. No pulse was palpable in the radial or in the brachial. The wound closed in the usual manner without drainage and the arm fastened to the side of the chest.

Post-operative history. Recovery from the anæsthetic was good. Temperature rose to 101° the following day but subsided. Some pain in the arm, very little œdema, and the temperature on the affected arm slightly below normal. Patient had considerable pain in the arm, but sensation of heat and cold, sharp and dull, was acute even in the tips of the fingers. There was a faint pulse in the radial on the eighth day, but this disappeared again, and later, and only at intervals and in certain positions, was the pulse palpable. The course, however, was a steady improvement, and six weeks later there was a distinct pulse in the radial which is apparently not a recurrent pulse. There is still marked neuritis in the fingers which is slowly improving under massage and electricity. The circulation in the fingers is apparently normal, though the motion is not quite perfect. A report from the patient twelve weeks after the operation says there is much improvement, and that the nutrition of the hand is perfect, but there is some occasional pain in the arm.

The case seems to me to present two problems that perhaps cannot as yet be definitely answered. The first is the question of the pain in the arm. Is this due to the disturbance of the circulation of the arm, or to a direct injury to the great nerve-trunks at the time of injury? As has been said, no visible lesion of the nerves could be seen, but it is seemingly impossible that a bullet should pass through this

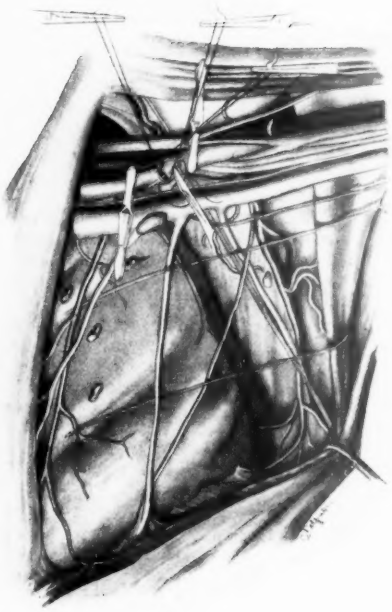


Fig. 1. Drawing showing site of injury and position of the sutures.

portion of the axillary artery and not damage very materially the great nerves. There surely can be no complete severance of the nerve-trunks, for the patient has had a sense of touch and an ability to distinguish between sharp and dull ever since two or three days after the operation.

On the other hand the blood supply has not been interfered with enough to show the least impoverishment of the muscle or skin and it is unlikely that the nerves would be so easily affected. Apparently neither the trophic nor motor nerves are seriously impaired; only the sensory being affected. In the dogs on which I have performed experimental transfusion, using the femoral artery, there is always a paralysis for a week or less, but this improves and by the expiration of three weeks is entirely restored to normal. In these cases there is, of course, no injury at all done to the nerves and the affection must be the result of the deprivation of the blood supply to the nerves.

The second problem is, Why does the circulation, i.e., the pulse, delay in its appearance for a period of days? The reports of cases in the literature show that in various arterial end-to-end anastomoses only one or two have had an immediate return of the pulse, and in the remainder the appearance dates from two to twenty days after the operation. It must also be borne in mind where the wound is not complete that there is usually a partial, constant stream of blood through the vessel and even an end-to-end anastomosis done for this type is more likely to result in immediate return of pulse, as there is less time for a thrombus to form. The delay in the appearance of the pulse can be due to one of two factors: (1) either there is a thrombosis of the artery distal to the suture, and this is later canalized, or (2) there is an establishment of the collateral circulation and later a return to the main trunk; or in other words, a recurrent pulse. After complete transverse rupture of a large artery the distal portion tends to bleed but little if any because there is no "*vis a tergo*" to force it. However, there is always some blood left in the artery and this might easily clot and obstruct the vessel. Should this occur there is only one way in which the circulation may be established through the accustomed channel after the artery is joined again, and that is by canalization or some similar measure as autolysis, absorption, or other allied process. Upon the time necessary to produce the passageway through this clot would depend the length of time that the pulse would be absent. For example, an injury sutured before there had been an opportunity for the blood to clot would undoubtedly produce a pulse in the most distal portion of the artery at once, while an artery sutured one to twenty hours later would exhibit a delay due to the thrombus that would have formed, and this thrombus might later be canalized or the thrombus might not extend proximally farther than a few inches and the collaterals might bring in the flow at a later period. How long might be required for the canalization I do not believe has ever been accurately determined,

but I should think from opinions expressed not under a period of weeks (Adami's Pathology). In speaking of canalization it is used in this paper to include the more specific terms, organization, absorption, autolysis, etc. It is of course possible that the swelling of the tissues might obliterate the pulse for a time after the anastomosis had been made, but that would hardly be great enough to exclude the pulse altogether for a period of days.

Since writing this article I have had an opportunity to suture the brachial artery in the upper third of the arm. In this case the artery was cut three-fourths of its circumference. The bleeding here had been profuse and had to be controlled by a tourniquet for three-quarters of an hour previous to operation. A lateral suture was made in the artery with the same fine silk and needles as mentioned in the first case. No leakage at all. The pulse in the radial did not return for eighteen hours after the operation, though it was present below the point of suture immediately after suture and now (three days after suture) there is a gradually increasing volume which at the present time is almost as good as that in the unaffected arm. There has been less pain in this case than in the case above reported although the median nerve was completely severed. The nutrition of the hand is perfect, and no œdema. There is anæsthesia in some parts of the hand supplied by the median nerve. This case is cited as another instance of the pulse not returning immediately, although there was only a lateral suture necessary and the flow of blood had been checked only so long as the tourniquet was in position, but this was enough to form a clot which had later to be changed in some way, within eighteen hours in this case. This type of case, i.e., where the circulation is delayed for a long time, shows how important it is, even in cases where the pulse may never return, to make an anastomosis rather than a ligation because the immediate results are not the measure of the full success.

I wish to express my thanks to Drs. Maupin and Burnett for their assistance and to Miss Edna Dolfinger for her splendid representation of the operation pictorially.

Appended is a bibliography as complete as I can find of the suture of the axillary artery. This includes many lateral sutures. In none can I find any explanation of the delayed pulse or the accompanying nervous symptoms. A splendidly arranged bibliography of all the end-to-end sutures of various arteries previous to 1913 is to be found in an article by Buchanan in SURGERY, GYNECOLOGY AND OBSTETRICS, 1912, xv, 648.

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END-TO-END

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ARTHRITIS OF THE JOINTS OF THE HAND FOLLOWING COLLES' FRACTURE[1]

By PRESCOTT LE BRETON, M.D., Buffalo, New York

IN the *American Journal of Orthopedic Surgery* for November, 1911, appeared an article by the writer entitled, "Traumatic Arthritis, as a Late Complication of Fractures of the Upper Extremities." This article discussed at length five cases seen in practice, in which there developed, from three to six weeks after a fracture, a progressive inflammation of the joints of the fingers and wrist. This inflammation, evidenced by swelling, severe pain, œdema, stiffness, and muscle atrophy, increased to a climax during a period of two to four weeks, and then more gradually subsided. The most characteristic feature was the inability of the patient to approximate the finger tips to the palm; in other words, "to make a fist." During convalescence the pain was in each case marked on attempted motion, the grip weak, the circulation poor. An atrophic appearance of the part was evident on inspection and an atrophic appearance of the bones on X-ray examination. The patients were all females, well along in life, and in most of them there was a tendency to arteriosclerosis. Four were cases of Colles' fracture and one of fracture of the neck of the humerus. The literature was searched at the Army Medical Library in Washington, but nothing found to explain the condition.

Since 1911, when this article appeared, the writer has closely followed four more cases of this nature. A fifth case, the only man in the series, was seen for a few moments only in a hospital in Philadelphia, but the history was typical and the diagnosis self-evident on inspection of the stiff hand. Three of the five had had Colles' fracture, one fracture of the neck of the humerus, and one, the male, dislocation of the head of the humerus. These cases varied in age from 43 to 70, and four showed arteriosclerosis. This second list of five patients varies from the first set of five in the facts that one case died before the climax of the condition was over, and that one was a male. These cases were in good health, with little or no history of a rheumatic nature. The fractures were well reduced; the splinting had not been too tight or prolonged. The splints were removed at the usual time and massage and passive motion started. The slow onset of œdema and pain, the spindle-shaped swelling of each individual finger-joint, the inability "to make a fist," the sleepless nights, the bitter complaint of the ineffectiveness of treatment, the tendency of the inflammation to increase to a certain climax and then more slowly subside, leaving a crippled hand, all formed a clinical group of symptoms exactly as in the first list reported. It is only necessary to refer to the anxieties of the patient or of the surgeon, to the possibilities of a malpractice suit, or to the probability of a more or less crippled hand to make a surgeon recognize the importance of the condition when once established.

In studying these cases the following facts are evident: The arthritis is not due to tight splinting, as shown by the statements of patient and attendant. The course of the fracture is normal and the swelling begins shortly before or after removing the splints for good. It is not a neuritis, as there are no tender nerves, no true paralysis, and no numbness except such as follows œdema. Tuberculosis, gonorrhœa, and rheumatism are easily excluded. The clinical picture is so striking and so unlike other conditions that the diagnosis, as such, is easy. It can only be stated that it must be of the nature of a traumatic arthritis following as a late complication of fractures or injuries of the upper extremity, especially Colles' fracture.

In several patients there was some involvement of the elbow-joint. In some there were adhesions that were formed along the extensor and flexor tendons. In one there was noted a slight Dupuytren's contraction of the palmar fascia. In the previous article there

[1] Read at a meeting of the Medical Society of the County of Erie, October 19, 1914

were quotations about the connection between arteriosclerosis and traumatic arthritis which will not be repeated here.

As regards the treatment, the writer has formulated the following: In the first place I inform the patient and the physician who cared for the fracture that the arthritis is not exceptional and that no one is to blame; that the hand will get worse before it begins to get better; that until pain and swelling begin to subside a light splint is needed for protection, sedatives are needed for sleep, and that as local treatment hot-air baking

Fig. 1. Case 1. One year after arthritis, showing crippled hand.

and gentle massage may be used daily. Aspirin and other drugs may be tried but are of little use. Later, Swedish massage and motions, hot-air baking, local and general, stimulant treatment, such as vibration, light, electricity, and the use of the hand. If in due time there is much stiffness, forcible motion under gas is permissible, but if too violent this causes a reaction which retards recovery.

The prognosis should be guarded. Six months to two years elapse before recovery. In these ten cases four may be said to have regained a normal hand. Two are still convalescing. Three were permanently crippled, and one died of cardiac complications

Fig. 2. Case 4. Six weeks after fracture, showing climax.

two months after the fracture, with the hand still swollen, stiff, and extremely tender and painful.

In reporting the cases two X-rays only are repeated in this article because they show simply a general bone atrophy. The cuts indicate the appearance of the hands.

CASE HISTORIES

CASE 1. (Author's own case.) Woman, aged 55; housewife. Previous and present history good. On June 29, 1909, she fell and sustained a Colles' fracture of the right wrist. Very little force straightened the wrist and two wood splints were applied. After the first day there was no pain or unusual sign. The X-ray showed simply a transverse crack. Free motion of fingers. At the end of the third

Fig. 3. Case 5. Eight weeks after fracture, just after acute stage. Some œdema. Beginning atrophy.

Fig. 4. Case 8. Ten weeks after fracture. Attempt is being made to flex fingers.

week complaint was made of aching in the wrist and hand. The dressings were removed as had been done before; some œdema was found and massage given. As the symptoms increased, the splints were replaced by an adhesive strap and a wet dressing applied of aluminum acetate. At that time there was a diffuse œdema up to the elbow, with spindle-shaped swelling of the finger-joints. All motions limited and painful. There was no paralysis or anæsthesia, but numbness of the skin, weakness, and atrophy of the muscles. Hot-air bakings and massage were given. Nine weeks after receiving the fracture, as the symptoms had improved a little, the patient was given gas and the joints moved with moderate force. Many adhesions were broken in the joints. Great swelling and pain ensued. One month later the stretching was repeated with better results. June 24, 1910, almost one year after the fracture, an X-ray was made and the hand (see Fig. 1) photographed. There was one-half inch atrophy of the forearm and atrophy of the interossei. The skin was glossy and atrophic. Sensation was good and power fair. Limitation of motion was the chief sign. She was unable to make a fist, and the wrist motions were not normal. Since then there has been little gain.

CASE 2. Woman, aged 35; salesgirl. About five years ago she had had aching and pain throughout the left arm for some months. The diagnosis was rheumatic neuritis and recovery was complete after treatment. On April 30, 1909, she fell and broke the left wrist. Dr. Hendee reduced it and applied a posterior splint with adhesive. The next day the writer made an X-ray and found a transverse crack in the radius with no deformity. Motion and massage were given later. At the end of the fourth week the splint was removed and free use allowed. One week later the hand and wrist

Fig. 5. Case 9. Six weeks after fracture, arthritis at the climax.

began to swell and stiffen. Some redness appeared next day and the finger-joints became spindle-shaped. On June 10 another X-ray was taken, but except for some general atrophy of the bone, this picture was identical with the first. Local treatments and antirheumatic remedies were ordered. Two weeks later, in consultation, it was pronounced subacute inflammatory rheumatism, although the arthritis was confined to the one hand. Three weeks later another consultant suggested tuberculosis. By September 5 there was general improvement. Motion at the wrist was 80 per cent of normal. Six months later the skin was still atrophic and shiny, the muscles small, the grip poor. Six months later the grip was weak, but the color pink and normal. The thumb and wrist had entirely recovered. The most characteristic feature was that the finger tips could not be made to touch the palm, although the middle and ring fingers came within one-half inch of it. She has practically recovered the use of her hand.

CASE 3. Woman, aged 55; housewife. Previous health good. On November 26, 1907, she fell on the sidewalk and hurt her right shoulder. Dr. Hayd diagnosed a fracture of the surgical neck of the humerus with some impaction. As it was impossible to adduct the arm, he used some force to bring the arm to the side, and applied a shoulder cap and a Velpeau bandage, leaving the hand free. Later the X-ray confirmed the diagnosis and showed fairly good position of the fragments. The course was normal until the end of the fifth week, some time after the forearm had been released from the

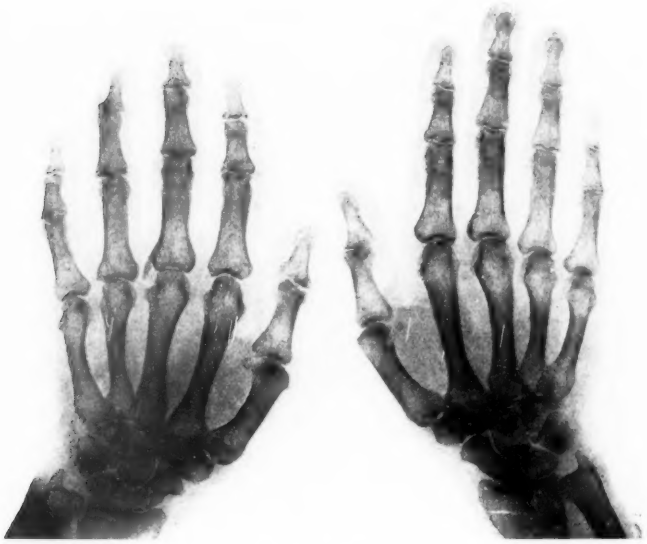

Fig. 6. X-ray.

bandage. An inflammation began with swelling, pain, and numbness in the hand and forearm. This rapidly increased. An examination was made under chloroform and some slight force used to break up adhesions. The pain after this was terrific and continuous, the superficial œdema hard, and the arm motionless to the elbow. Three weeks after the onset of the trouble, Dr. Hayd asked the writer to take charge of the case, as he was going out of town. At that time the swelling and pain had begun to lessen. The scapula moved with the humerus and abduction was limited to ninety degrees. At the elbow there was good flexion but very limited extension. Pronation and supination were free. The wrist and fingers were very stiff and passive motion extremely painful. The treatments were hot-air bakings, massage, and faradism. Improvement was slow. Two and one-half years later there was good use of the arm except for fine motions; e.g., buttoning her waist. At the shoulder external rotation and abduction were limited; at the elbow full extension was impossible; wrist free; thumb showed slight limitations. On attempted flexion of the fingers the finger tips approached within one inch of the palm.

CASE 4. Woman, aged 49, referred by Dr. Eugene Smith. Housewife. Always in good health, but has one sister who has been badly crippled for the past year with some form of chronic joint trouble afflicting many joints. On February 12, 1911, she fell and sustained a Colles' fracture of the left wrist. An X-ray showed almost no displacement. Wooden splints were applied and the fingers allowed freedom. No pain. At the end of two weeks the splints were removed daily for passive motion. Some slight stiffness and puffiness noticed. After this there was a progressive onset of pain, stiffness, œdema, and swelling of all the small joints of the hand (see Fig. 2). The climax of pain was reached about six weeks after the fracture. The writer saw her March 31 and began to treat her. Since then there was slow improvement, but at the end of six months a partial crippling remained. This case has been lost sight of.

CASE 5. Woman, aged 60, referred by Dr. Joseph Lewis. Housewife. In good health. Examined April 19, 1911. Eight weeks previously a fall resulted in a Colles' fracture of the right wrist. No X-ray. Easily reduced and treated by a plaster of Paris molded splint. At the beginning of the fifth week aching was noticed in the hand and fingers and stiffness of the small joints. There was a steady onset of severe pain, œdema, stiffness, and trophic changes. Climax in the seventh week. Hand photographed at the end of the eighth week, showing the condition after improvement had begun (see Fig. 3). There followed slow gain, and at the present time there is a practical cure.

CASE 6. Woman, aged 55; single. A small, frail woman, with fairly marked arteriosclerosis. Examined February 5, 1912. Four months previously she had received a Colles' fracture of the left wrist, which was reduced and treated by a plaster of Paris splint. This was removed at intervals for massage and inspection. During the latter part of this period she suffered greatly from pain and on removal of the splint found her hand quite stiff and swollen and the fingers unable to meet the palm. The

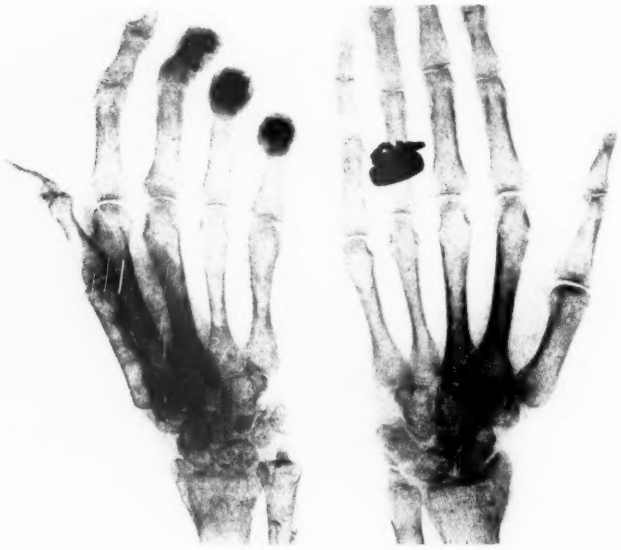

Fig. 7. X-ray.

condition grew worse and another physician who was called in treated her by forced motion and local applications. As there was no improvement, a friend asked her to see the writer, who found rigidity of all the small joints of the hand. There were the usual atrophy of muscles, atrophic appearance, tenderness, and clawlike hand. Motion under gas was tried, passive motion, and baking, but the hand remained permanently crippled. An X-ray showed a slight deformity of the wrist and much atrophy of bone. About a year later she died of some intercurrent trouble.

CASE 7. (Author's own case.) Woman, aged 70. Had enjoyed exceptional health for many years. January 6, 1914, she sent for the writer, stating she had fallen the previous evening and hurt her left wrist. An X-ray disclosed a transverse crack of the radius without deformity. Wooden splints with adhesive were applied for three weeks. The course was normal till the third week, when pain was complained of. On removing the dressing, as had been done before, the condition was recognized and a masseuse obtained to start light massage and bakings. This case was the worst because there was no improvement to the time of her death, about two months later, when the hand was still swollen, glazed, atrophic, perfectly stiff, and so sensitive that even while in coma, if the hand was moved, there was a change in respiration and a reflex contraction of the arm muscles. Five weeks after the fracture she had a severe bronchitis and was sick for several days. Soon after getting about she fainted and Dr. Getman found a high blood pressure and a very weak, irregular pulse. She was put to bed and treated medicinally. She became weaker and more prostrated so that the treatment of the hand was stopped altogether. She then became maniacal and lapsed into coma, which continued nearly a week before her death. It would seem that there was some connection between the arthritis and the affection of her circulatory system.

CASE 8. Woman, aged 75, referred by Dr. Rasbach, March 10, 1914. History good, except that she had been troubled by constipation, hemorrhoids, and a soreness of the muscles that she called rheumatism. Three months previously she had had a fracture of the surgical neck of the left humerus, with impaction. Considerable hæmatoma had formed from rupture of a vein. This swelling caused no pressure of the brachial plexus. A light Velpeau dressing was used at first, but after the fourth day a sling only was used. The hæmatoma was absorbed and motion started at the usual time. The swelling and pain in the left hand began slowly at the beginning of the fifth week, increased and remained at a climax for four weeks. There was extreme pain, insomnia, pain on motion, and swelling of individual joints. The cut (Fig. 4) shows the condition ten weeks after fracture, when she is attempting to "make a fist." The treatment was general, plus body baths, massage, and baking. At the present time, seven months after the fracture, she has largely recovered and is still improving. The shoulder is in excellent condition. In fact, while the hand was most swollen the shoulder had recovered enough for her to place the hand on top or behind her head.

CASE 9. Woman, aged 43, referred by Dr. Weil,

September 5, 1914. Housewife. Ten years ago she had had a fall on the back, which was followed by a partial paraplegia and partial loss of bladder control. Complete recovery in three months. Six weeks before examination by the writer she fell and hurt her right wrist. Dr. Weil had an X-ray taken, which showed linear fracture without displacement. A plaster splint was used for four weeks. The fingers were moved from the first and the splint removed once a week. In the fifth week the hand, which had been slightly swollen, became inflamed and so painful on any motion that a light splint was again applied. The cut (Fig. 5) shows the condition in the sixth week. The hand was hot and tender and each joint swollen. All motions limited and painful and shoulder-joint motion slightly restricted. There was bitter complaint of the pain and insomnia. Rapid improvement has taken place in this case, due to body bakings.

CASE 10. Man, aged about 65, seen in the clinic of the University Hospital of Philadelphia, in June, 1914. This man, among other patients, was being shown by Dr. T. Turner Thomas as a case of previous shoulder dislocation. The doctor stated that during convalescence the man had had an unusual trouble with the hand, from which he had not recovered. The writer called the patient to him and asked the man to "make a fist." He said he could not. In fact, he could not bring his finger tips within an inch of the palm. The usual atrophic appearance, stiff joints, and pain on forced motion were present. A subsequent conversation with Dr. Thomas confirmed the diagnosis.

NOTE.—Since reading this article, a physician gave the writer the following history of his own case, which was one of arthritis of the joints of the fingers and wrist, following six weeks after a Colles' fracture. The history differs in these particulars: he was young at the time, the deformity was imperfectly corrected after the interval of a week, and the X-ray now shows deformity and permanent joint changes. Male, aged 22, in good health. Fell from a pony while playing polo, fracturing the right clavicle and three ribs and receiving a Colles' fracture of the right wrist. When examined some hours later, the swelling was so great at the wrist that no attempt at reduction was made. One week later, in New York, a surgeon succeeded in a partial reduction with the aid of an anæsthetic. After that the course was uneventful until the end of the sixth week, when the splint was removed. Then he began to suffer severe pain and all the joints of the hand and wrist swelled and remained so for three months. There was great pain, tenderness, and pain on motion. The attendant stated that it looked like an arthritis deformans. In one year he recovered the use of the hand but the wrist has remained partially crippled.

AN INTRAGASTRIC ADHESION

WITH THE REPORT OF A CASE

BY C. HUGH McKENNA, M.D., CHICAGO
Surgeon to St. Joseph's Hospital

CONSIDERABLE progress has been made in the past few years in the interpretation of pathological lesions of the stomach and intestines by means of X-ray pictures following bismuth or barium meals. However, I am of the opinion that in the hands of experienced surgeons, this data in many instances is held in a skeptical way from a diagnostic point of view, since so frequently at operation the findings apparently do not correspond with the readings from the X-ray plates.

I wish briefly to present a stomach case with the accompanying clinical data and an X-ray picture which appears to be unique: first, because of the X-ray shadows produced; and second, because of the findings at operation. I believe in a measure this case explains our inability at times to perfectly interpret X-ray pictures. I have chosen to call these lesions "intragastric bands or adhesions" and this condition is beautifully demonstrated in the accompanying picture (Fig. 1).

At operation, an indurated saddle ulcer with the base about the size of a quarter of a dollar was found in the cardiac portion of the lesser curvature of the stomach — contrary to what we expected to find in this case which was an atypical hour-glass stomach. The stomach showed only slight contraction at this point but the condition in no way gave the appearance of marked fissure shown in the accompanying plate. The ulcer was resected by means of a diamond-shaped incision and adherent to its floor was a tongue-shaped band of mucous membrane from the opposite side of the stomach wall,

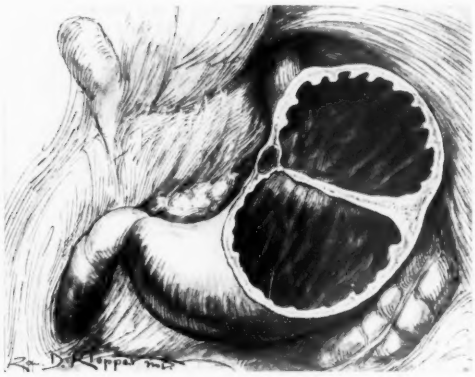

Fig. 1.

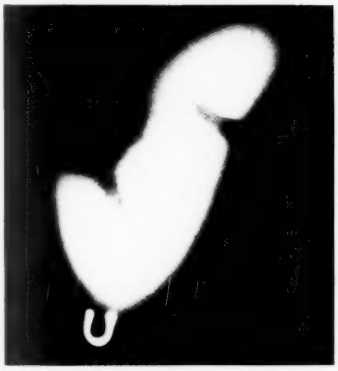

Fig. 2.

the greater curvature. This condition appears to have been brought about by a contact ulcer. Evidently the mucous tongue had stretched without drawing the muscular and serous coats with it.

In this instance the X-ray picture gave a true shadow of the pathological condition, but would have been impossible of correct interpretation had not the stomach been opened. Had there not been a suspicion of malignancy about the lesion, it might very properly (owing to its location) have been left intact and the case turned over for medical treatment.

In a relatively large experience in gastric surgery, I am of the opinion that if it be possible and proper to examine the interior of the stomach wall, surgeons will find a gradually decreasing number of cases where the X-ray findings and the lesions at operation are at variance.

CASE. Miss J. J. Present complaint: First attack six years ago. Following a dinner party patient was taken with a severe spell of nausea and vomiting and severe griping pain in the epigastrium. She fainted during this spell. She fasted for several months, during which time she had very few vomiting spells but severe cutting and griping pains in epigastrium. This pain seemed to come on about an hour and a half after eating. Eating would relieve the pain for a short time. Soda also would relieve the pain. The pain was often so severe that the patient doubled up like a jack-knife. This pain was most severe below the xyphoid and slightly to left side. It remained rather localized. Patient never noticed blood in the vomitus nor did she notice food eaten the night before in the morning vomitus. After vomiting she felt relieved. She has lost much weight of late, she thinks about 30 pounds in last two months Patient ailed for two years following the first attack six years ago. This last attack is of six weeks' duration. It is similar to the one described above. More vomiting in this attack than in the other. No blood in vomitus.

Past history: Diphtheria two times. Pneumonia at 14 years. Family history, negative. Habits: Tea and coffee not at all. Milk a great deal Fairly good eater. Appetite good. Bowels sluggish. Examination: Head negative, chest negative.

THROMBOSIS AND EMBOLISM[1]

By ANGUS McLEAN, M.D., Detroit

A CONDITION which has been before the medical profession for many years, especially since the inception of modern surgery and modern surgical technique — a condition which is becoming more frequent with the ever-increasing number of abdominal and pelvic operations — a condition about which much has been written but concerning which little is known definitely, is the subject I wish to bring to the attention of this society this evening.

Several etiological factors are usually given as necessary for the formation of a thrombus: (1) trauma, especially injury to the endothelial lining; (2) stagnation or slowing of the blood-stream; (3) chemical changes in the blood itself, and (4) infection. Regarding these causes it is hardly necessary to say that not one is alone sufficient to produce a thrombus. When a thrombus does occur it is usually due to various combinations of these causes acting together. Again thrombosis often occurs, as for instance, a femoral thrombosis, following an apparently surgically clean appendectomy, when, as far as we can ascertain, each one of these factors is wanting. We are therefore forced to look for some other etiologic factor in such cases. With the hope of finding some explanation for the thrombotic process in these cases, we undertook some experiments on dogs.

EXPERIMENTAL WORK[2]

Experimentally, thrombosis is a difficult subject to work with, first, because of the difficulties that confront us in blood-vessel surgery generally and in the post-mortem findings in particular (as for instance locating the point of lodgment of an embolus), and second, because the conditions under which thrombosis and embolus occur in the human being are difficult to imitate, simply because no one single, definite, etiologic factor is generally accepted.

In our experiments we were much impressed with the tremendous amount of injury a vein can withstand without the production of a thrombus at the site of injury. Indeed, it is quite a difficult problem to produce a thrombus experimentally. In daily surgical work, all of us avoid injuring blood-vessels as much as possible; we always fear the possibility of causing the development of a thrombus.

In our study we noticed several interesting phenomena, namely:

1. When a vein is ligated in continuity the blood in the vein will clot only on one side of the point of ligation; that is, the side from which the blood is coming.

2. In ligating a vein between two ligatures (say two inches apart) the blood between the ligatures clots very slowly, and if left for a week or more the contents of the ligated vein will have entirely disappeared, a fibrous cord-like structure alone remaining.

3. The same result is accomplished by ligating an artery between two ligatures.

4. Simple crushing of a vein will not cause a clot at the point of crushing. The crushing can be repeated in forty-eight hours and a clot will not form at the site. Examination of the repeatedly crushed vein two weeks after the last crushing will show a thickening of all the coats of the vein due to an increased amount of fibrous tissue, the intima remaining as smooth and glistening as before.

5. Crushing of a vein with the subsequent introduction of a twenty-four-hour bouillon culture of staphylococci, and again crushing the vein to grind (as it were) the staphylococci into the walls of the vein, will not produce a clot or thrombus at the site of the crushing and injection of the staphylococci.

6. The introduction of a sterile thread into the lumen of a vein, allowing about one-half to three-quarters of an inch to remain suspended inside of the vein, that is, oscillating in the blood-stream, failed to produce a clot or thrombus either at the point of the introduction of the thread or around the thread itself (see Fig. 1).

[2] Experiments performed under ether anæsthesia.

[1] Read before the Chicago Surgical Society, January 8, 1915. (See discussion p. 495.)

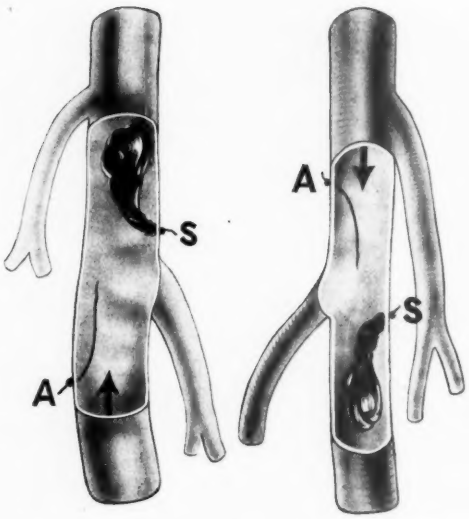

Fig. 1, at left. Section of vein. A, sterile thread (no clot after five days). S, septic thread (staphylococcus aureus). Thrombus present around thread in five days.

Fig. 2. Section of artery. A, sterile thread (no clot after five days). S, septic thread (staphylococcus aureus) Thrombus present around thread in five days.

7. A sterile thread introduced into the artery in the same way and allowed to remain there for four, five, and seven days will not cause the formation of a clot on the thread itself nor upon the wall of the artery at the point the thread was introduced (see Fig. 2).

8. The introduction into a vein of a thread infected with staphylococcus albus or aureus will in three or four days cause the formation of a thrombus at the point of the introduction of the infected thread. The thrombus becomes attached to the vein at the point where the infected thread enters. It will not entirely occlude the lumen of the vein; it will grow or enlarge in the direction of the blood-stream, remaining suspended at a single point (see Fig. 1).

9. A thread infected either with the colon bacillus or with the staphylococcus aureus, introduced into an artery, causes the formation of a firm clot as proved by post-mortem findings five days after the introduction of the thread (see Fig. 2).

10. Sterile threads, one-half inch long, "let go" in the circulation caused no symptoms up to the present writing (7 weeks).

11. An infected thread (colon bacillus) one inch long, let loose in the circulation, caused a sudden death in 3½ days. Post-mortem examination showed a seropurulent fluid in the pleural cavity and the embolus (thread with blood-clot, infected with colon bacillus, around it) was found in right lung (see Fig. 3).

On examination of an induced thrombus of this kind it can readily be seen how easily such a thrombus could be torn from its small frail attachment, circulate in the blood-stream and become lodged somewhere in the pulmonary circulation and perhaps produce a fatal termination just as happened in experiment noted in paragraph 11 above.

It is difficult to conceive a condition in a patient similar to the one in which we were able to produce a thrombus in the dog; but the difficulty found in producing a thrombus experimentally shows that there must be factors other than injury to the vessel, slowing of the blood-stream, and chemical changes that bring about a thrombotic process in human beings. We believe infection, or necrosis, or both, are quite essential. Whether the infection, *per se*, is the etiologic factor or whether the toxins, derived from the infectious or necrotic material, are the real agents, we do not know. Whether these substances cause first a hæmolysis, a conglutination of the platelets and red corpuscles — a view usually held in regard to the method of thrombus formation — or whether these are substances akin to fibrinogen, and thus directly cause the coagulation of blood in the vessels, also is not known. Is it perhaps possible, when thrombosis occurs after an apparently surgically clean operation, that during the operation certain ligatures have been placed in such a way as entirely to cut off the blood supply to certain areas, which contain a low-grade infection and subsequently become necrotic and liberate the substances necessary to complete the coagulation of blood in the surrounding vessels?

RELATION OF THROMBOSIS AND EMBOLISM TO OPERATION

In looking up the statistics we find that thrombosis and embolism follow operations for large pelvic tumors more frequently than

any other operations. Of forty-eight reported cases collected by Schenck, 58 per cent followed operations for the removal of large pelvic tumors. Schenck, also shows that in 3,204 myoma operations from twelve different clinics, namely, those of Goldman, Burnham, Wenczel, Duvergey, Hofmeier, Klein, Zurhelle, and Kelly, ninety-six, or 3 per cent, were followed by thrombosis. My own record of the last two years shows that in 1610 laparotomies there were 33 cases, or about 2.2 per, cent that were followed by thrombosis or embolism. There were nine cases of fatal embolism; three cases of pulmonary embolus in which the patients recovered without further trouble, two cases of pulmonary embolus followed by lung abscess with recovery, 2 cases of embolus of the liver followed by hepatic abscesses with one recovery, and two cases of cerebral embolus followed by death. Besides these cases of embolism there were fifteen cases of femoral thrombosis, all of which followed pelvic operations. Of the eighteen cases of embolism, eight, or 44.4 per cent, followed prostatectomies and hysterectomies. The striking thing in all cases of embolism and thrombosis in our series is that there was only one case of embolism with recovery and no cases at all of thrombosis that followed operations in the upper abdomen. This one case followed an operation for suppurative gall-bladder disease. In the cases that are most frequently followed by thrombosis and embolism there is always a certain amount of pressure exerted on surrounding structures. The circulation, especially the venous circulation, is retarded and extensive varicosities are quite common. There is also ample opportunity in these cases for remnants of tissue remaining either in the form of devitalized pedicles or, as in the case of a prostatectomy, shreds of connective tissue, which subsequently become necrotic, perhaps harbor a low-grade infection, and give off the substances necessary for the development of a thrombus.

Perhaps the most striking proof of the theory that necrotic tissue plus a non-virulent infection does cause thrombosis is presented in those cases of pyosalpinx in which the whole fallopian tube is adherent and necrotic and can be removed entirely without ligating a single vessel. Similarly a necrotic appendix can be removed without ligating the appendicular artery. Here ligation is not necessary because all the veins and arteries are already thrombosed from being in proximity to the necrotic tissue. The bleeding that does occur in these cases is simply an oozing from the newly formed capillaries that have developed in the adhesion.

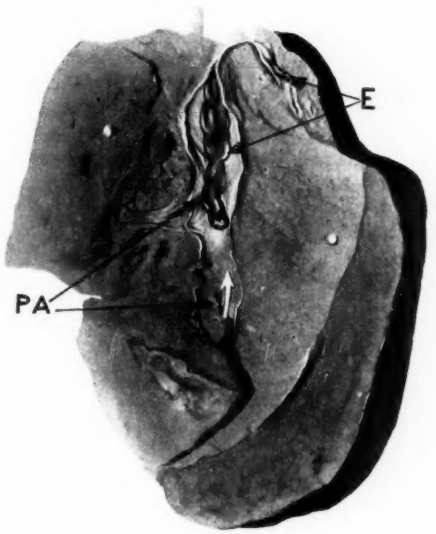

Fig. 3. Section of lung. PA, pulmonary artery laid open showing enclosed embolus. E, embolus around infected thread carried from femoral vein.

We know that thrombosis is more apt to follow septic cases than aseptic ones. In these cases the infection that is contributary to the thrombus formation is quite evident. Coincident with the infection there is always an inflammation and in the first stages of inflammation a slowing of the blood-stream is noticeable. It would indeed be surprising if evident septic cases did not furnish the greatest percentage of post-operative thrombosis, for here are present in a marked degree the two factors upon which thrombosis mainly depends.

Thrombosis and its consequent embolism rarely occurs before the eighth day. The usual time is from the eighth to the twenty-first day. Recently a case came to my notice

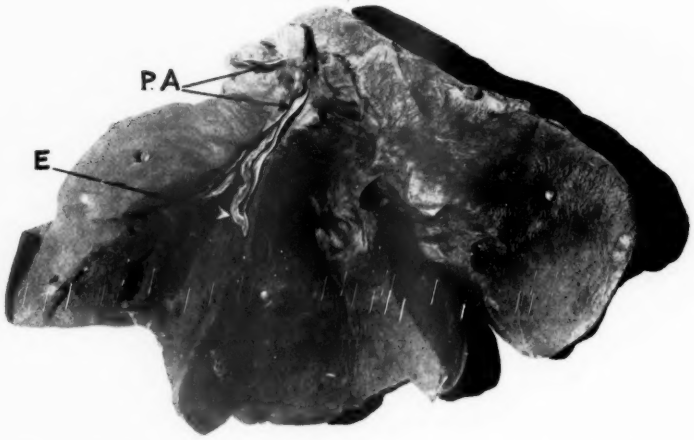

Fig. 4. Section of lung. PA, pulmonary artery laid open showing embolus. E, embolus, origin indefinite, caused death of dog in course of thrombosis experiments.

in which a fatal embolism occurred as late as two months after an operation for a uterine myoma. This is a rather slow process, but complete necrosis of the tissue, on which thrombosis depends to a great extent, is not a rapid process. It usually takes a week or ten days, about the length of time in which thrombosis usually appears. The thrombus that forms during this time may remain undisturbed almost indefinitely; on the other hand, at almost any time it may become dislodged wholly or in part, and give rise to an embolus. This explains why the time of the appearance of a thrombus is earlier and more constant as compared to the late and quite inconstant appearance of an embolus.

The great majority of post-operative thromboses, except perhaps those which occur after mastoid or sinus disease — and these occur in the internal jugular vein — are found in the long saphenous, femoral, or external iliac veins. In discussing the cause for the comparative frequency of femoral and iliac thrombosis, Clark came to the conclusion that it is due to the effect of traumatism exerted on the deep epigastric vein. The primary thrombosis originates in the deep epigastric vein and is slowly propagated along the line of that vessel until it reaches the external iliac vein, where it gives rise to a retrogressive thrombosis in the femoral vein. The long interval between the operation and the appearance of the femoral thrombosis suggests a slow process starting some distance away. It can be seen how a thrombus, once established in the deep epigastric vein, can be propagated to the femoral vein; but that simple trauma by retractors or the like should start a thrombotic process in the deep epigrastric veins seems rather improbable on the ground that the most severe injury can be inflicted on veins without causing a thrombus. Besides this, the thrombus occurs not infrequently on the side opposite the one in which traction was made on the deep epigastric vein.

Again, the valves of veins are often alluded to as predisposing to thrombus formation; but clinically, thrombi are found in locations where, anatomically, valves are absent, as for instance the dural sinuses.

In our cases of post-operative thrombosis, thrombosis in the long saphenous vein occurred relatively quite frequently, yet never did an embolus result from a thrombus in this location. Probably the anatomy of this vein explains why embolism did not follow its thrombosed condition. First, it is placed alone in the superficial fascia and does not receive the constant and repeated impulse

of an accompanying artery as do the femoral and iliac veins; consequently it is comparatively easy to keep this vein at absolute rest. Second, three veins, the superficial epigastric, the superior external pubic, and the superficial external iliac, enter either at right angles or even at acute angles against the current of blood and consequently cause a peculiar swirling of the blood stream at the points of their entrance which tends to prevent the passage of any solid material.

Can the formation of thrombosis and subsequent embolism be prevented? As long as we are unable to say exactly on what factors thrombosis depends, so long shall we be unable to say definitely whether or not we can prevent its formation. The probable causes as they present themselves today should, of course, be avoided. It is not possible to do this at all times. We cannot always avoid necrosis of tissue nor can we always avoid infection, for infections are often present before the case comes to the surgeon; in fact, they are very often the condition for which a patient seeks relief. Once a thrombus has formed, however, we can to a large extent avoid the occurrence of an embolus. The limb should be elevated to encourage the venous circulation, wrapped in cotton and surrounded with hot-water bags. Some advocate ligation of the vein proximal to the thrombus, but this we believe impractical in most cases and of doubtful benefit. Absolute rest must, however, be insisted on as a precaution against secondary embolism. This rest must be kept up until the clot has had a chance to become thoroughly organized, a process which will usually take from three to four weeks. If after the lapse of this time the patient is fortunate enough to have escaped the formation of a fatal pulmonary embolus from his thrombus, if he has escaped the long and tedious invalidism consequent on the lodgment of an embolus in his liver or elsewhere, his subjective suffering and discomfort is not at an end. Thayer examined a number of cases of post-operative venous thrombosis several years after their occurrence and found that, when the femoral and iliac veins were involved, the afflicted extremity was usually considerably and permanently enlarged. It presented varices often terminating in ulceration; in addition, there was marked weakness and cramps especially at night and on overexertion. Schenck was able to gather the late histories (that is, four years old) of twenty-nine patients in the forty-eight cases in the Johns Hopkins series. Eight of them had symptoms for about four months and subsequently no trouble. Two had some difficulty in walking for about twelve months. Nineteen never fully recovered, being troubled with swelling and with more or less pain. On this basis he concludes that "it is fair to assume that about 65 per cent of the patients never recover and that if complete restoration is to follow it will come before the end of the first year, by which time the collateral circulation is as completely established as it ever will be."

Some one has said that surgical morbidity does more to bring surgery into disrepute among the laity than surgical fatality. It is more lasting and it is continually and prominently before the people; whereas fatality is soon forgotten. If this is so, thrombosis and embolism more than any other condition should ever be in our minds as one of the possibilities that may put a practically indelible blot on even the most skilful surgery.

CONCLUSIONS

1. Endothelial damage, on which so much stress is usually laid, is not, *per se*, a cause of thrombosis.

2. Infection and necrosis or the toxins derived from an infectious and necrotic process are probably the most important factors in the production of a thrombus.

3. A slowing of the blood-stream is a contributory cause but, *per se*, will not cause a thrombus to form.

DEPARTMENT OF TECHNIQUE

URETER STONES; THE TECHNIQUE OF THEIR REMOVAL BY CYSTOSCOPIC METHODS

With Reports of Cases[1]

By BRANSFORD LEWIS, B.S., M.D., F.A.C.S., St. Louis
Professor of Genito-Urinary Surgery, Medical Department of St. Louis University; Genito-Urinary Surgeon, St. John's Hospital

IT will hardly be necessary before this association to plead the cause of early removal of a stone once it is identified as impacted in the ureter; if held there for long, whether large or small, its damaging effects are sure and not long delayed.

The one question still under discussion is, What is the best method of removing it?

Lester Leonard (1) said that in view of the frequency with which ureteral calculi are passed voluntarily (he claimed that 50 per cent of all cases were thus relieved) the expectant plan, inviting this outcome, should be relied on in all cases; whereas, on the other hand, we may read in the many essays of modern surgeons the advice to remove by open abdominal operation immediately the diagnosis is determined. No middle ground is accepted or entertained by these, and no consideration is given by many of them to cystoscopic methods of removal.

It would seem reasonable to assume that if the profession were acquainted with a method more sure of success than is the expectant plan (only 50 per cent successful), or less radical and dangerous than the abdominal operation, it would be willing to give it recognition and also to make use of it. That open operation is ordinarily attended with most gratifying success and prompt recovery does not change the fact that its outcome is not always satisfactory, nor is its employment always easy.

Medical literature of recent years contains many reports of experiences with open operations for ureteral stone removal, together with the impressions of the authors. From these it is apparent that such work is far from being uniformly easy and satisfactory. Deaver (2) tells us that the open operation for the removal of a calculus situated low down in the ureter may be one of the most difficult undertaken. A considerable number of the best operators in this country have been observed to search in vain for the supposed stone, or have reached it only after the quest has lasted for one or two hours. And they were happy, though not content, at finding it even then.

But the operators' troubles are not always over at the end of such a successful operation. Moschcowitz (3) has related the appalling developments in one of his cases, in which hæmorrhage occurred from both iliac vessels, subsequent to an operation done on each side of a patient, and the narrow escape from gangrene of the lower extremities. Peterkin (4) has recited the dramatic and tragic sequences following the use of open operations in three cases in his hands. They varied from prolonged infection, suppuration, fistula-formation, and invalidism to death. In a previous paper by the writer (5) other reports of a similar kind are quoted. But more important than this is the question of mortality. Tenney (6) has studied the mortality connected with such open operations and has concluded that it varies from 15 to 20 per cent. This alone is sufficient to evoke the wholesome respect of a profession devoted to conservatism and safty-first ideals.

If such be the case, it is only fair to say that while such operations should be carried out when required, their application should be avoided if the removal can be effected by a less hazardous procedure. This latter, if such there be, should at least be given a trial before resort is had to the more radical procedure.

A method less hazardous than open operation has been evolved; has been developed to a tangible and serviceable reality, and has proved its efficacy in a sufficient number of instances to justify its general recognition and its adoption by preference in all appropriate cases.

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December 16, 1914.

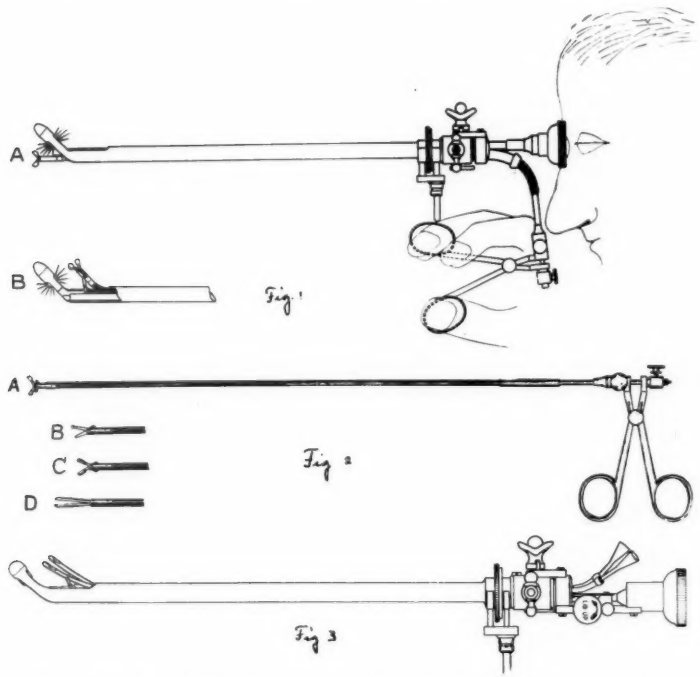

Fig. 1. The Bransford Lewis combined universal and operating cystoscope, latest model, 1914. A, forceps in use by direct method; B, same by indirect method.

Fig. 2. Appurtenances to Bransford Lewis universal and operating cystoscope, model 1914. A, flexible biting forceps; B, scissors; C, stone forceps; D, ureteral dilator.

Fig. 3. Double ureteral catheterization, indirect method.

Cystoscopic manipulations of various sorts have succeeded in removing ureteral stones in a very considerable number of cases (probably a hundred or more, up to the present date). Successes have been reported by Howard Kelly (7), Braasch (8), Young (9), Kreissl (10), Ashcraft (11), Moschcowitz (12), Casper, Schmidt, Robert Bryan (13), Harvey Moore (14), Perrier (15), myself (16), and others.

A formulated plan, together with instrumental equipment, was submitted by the writer, and its use was reported on at the Cincinnati meeting of the Mississippi Valley Medical Association, in 1904, and further discussion of the method was presented (16, b) before the American Urological Association in 1912.

This plan and equipment have been amplified and improved since their original presentation, but there has been no cause for regret in any instance in which it has been adopted. On the contrary, in the cases in which it has proved successful the patients have expressed their gratification and intense appreciation of the simplicity and innocuousness of the procedure, which had not menaced life or put them to serious inconvenience; while in cases of failure it has left the patients in no worse condition for the open operation than they would have been without it.

The writer would not like to be understood as making immoderate claims of unvarying success of the method. With certain cases it is feasible; with others it is not. Judgment and accurate diagnosis must be applied to determine the probabilities in a given case. But in numerous cases in which there is room for doubt as to the outcome, the patient should be given the benefit of this doubt: The less radical procedure should at least be given a trial before subjecting him to one that possesses elements of risk not inconsiderable.

The cystoscopic maneuvers that have been

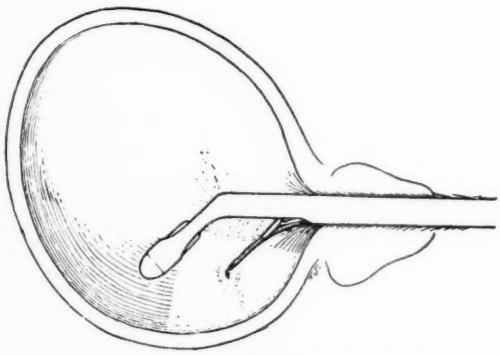

Fig. 4. Indirect method of ureteral catheterization.[1]

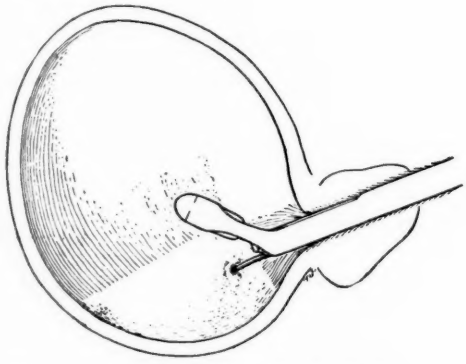

Fig. 5. Direct method of ureteral catheterization.

reported as giving successes in the removal of calculi have been mainly two: The injection of oil through a ureteral catheter, with the object of promoting the descent of the stone, and the teasing of a stone out of its niche with a catheter when hung in the ureteral orifice. While these measures are commendable and often successful, they are inadequate in many cases, and the more aggressive measures permitted by the operating cystoscope and appurtenances should give much greater efficiency and reliability.

Gratifying results were obtained with the operating cystoscope submitted in 1904, but its deficiencies led to the devising, during the present year (1914), of a new model, which not only accomplishes all the objects aimed at by both this and the universal cystoscope of the writer, but accomplishes them much better. In other words, the new model universal and operating cystoscope (Figs. 1, 2 and 3) consists of a single sheath of 23, French, outside caliber, that permits the use through it of observation telescopes (direct, right-angle, and retrospective), of catheterizing telescopes, and the several operating accessories essential for the work.

The great advantage derived from free irriga-

[1] Figs. 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 19, 20, and 21 from *Cystoscopy and Urethroscopy* by Lewis and Mark.

Fig. 6. Catheter approaching left ureteral orifice, direct method. Cystoscopic view.

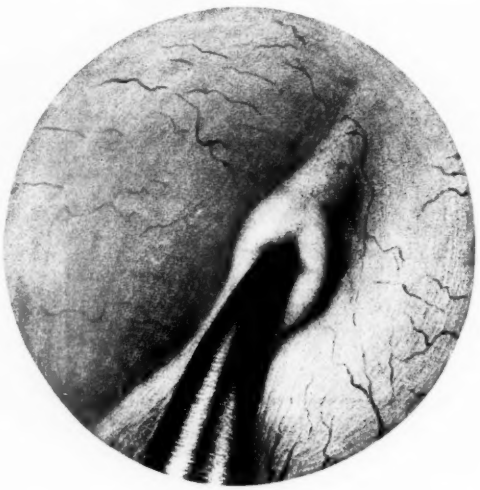

Fig. 7. Catheter passed up left ureter; direct method.

tion while the operator is at work has been retained in the present model. The shafts of the accessory instruments are now made flexible to permit of their use at an angle ("around the corner") (B., Fig. 1) as well as by the direct method (A., Fig. 1). This also permits the instruments (forceps, etc.) to thread the curves of the ureter to a much greater distance than the straight instruments with fixed shafts.

If constrictions are located high up in the ureter and beyond the reach of the metal accessories, reliance may then be had on flexible dilating bougies or catheters (Fig. 2) for widening the tract and paving the way to dislodgment and descent of the stone.

The following case reports will illustrate some interesting experiences in this work.

CASE 1. Stone symptoms nine months; cystoscopic manipulations; descent of stone shown by X-ray; recovery.

Chas. C. M——r, age 24, East St. Louis, Illinois. Arrived July 7, 1914. Symptoms began nine months ago; attacks of renal colic recurring every two or three weeks since that time, requiring the liberal use of morphia hypodermically. Catheter and X-ray showed a stone shadow about the crest of the right ilium. Oil injection. July 7, observation showed a stone emerging from the orifice of the right ureter. Attempts to grasp it pushed it further in, but the orifice was dilated. On looking into the bladder next day it was at once seen that the orifice was clear, and the stone lay in the base of the bladder. It was picked up and removed with alligator forceps. A catheter passed easily then into the pelvis of the kidney, and there were no more symptoms — the first relief for nine months. The stone was recovered and is shown herewith.

CASE 2. Symptoms thirteen months; open operative removal of one stone; cystoscopic removal of another from the same ureter.

J. S. F——l, age 44, foreman of a telephone company. April 2, 1914. Symptoms of recurrent renal colics for past thirteen months. Diagnosis of right renal stone was made a year ago by a physician who assured the patient he could dissolve it in a little time. This plan not having succeeded the patient came to me a year later. By ureteral catheterization and X-ray a stone was demonstrated to be in the right ureter, about three inches above the lower end (Fig. 18). Dilatings and oil injections failing to bring this down, it was removed by open operation on April 28, 1914. Recovery and closure of the wound followed satisfactorily, but a month later a sudden elevation of temperature led to the use of the cystoscope and ureteral catheter, and it was discovered that another stone existed in the right ureter a half inch above the orifices, plainly evident to X-ray and in contact with the catheter. With the operating cystoscope the orifice was incised with ureteral scissors. This was followed on the same night by the passage of a good sized stone (Fig. 19) and permanent relief from further symptoms. The stone was recovered and is in the collection shown (Fig. 20).

CASE 3. Symptoms two months; cystoscopic measures; recovery.

T. A. M——r, age 25, Laredo, Missouri, December 1, 1911. History of two months' duration, severe attacks of pain in left ureteral region, often requiring the use of morphine hypodermically, yet lasting two or three days and recurring about once a week. Friends had difficulty

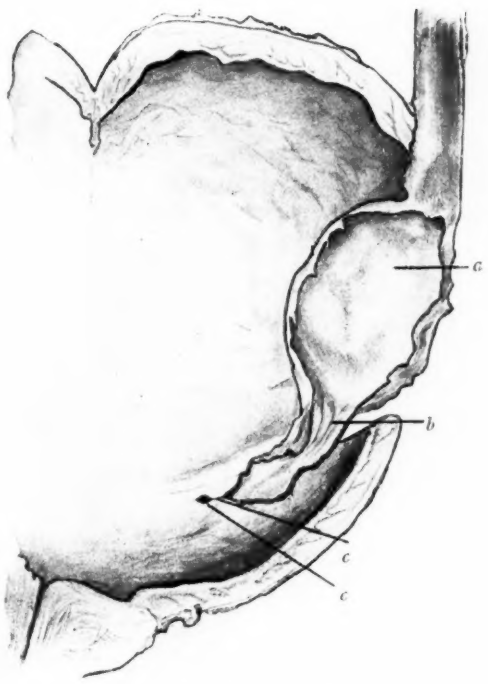

Fig. 8. Pathological specimen showing strictured ureteral orifice and dilatation above. a, Dilated left ureter; b, narrowing of ureter; c, minute strictured orifice.

in holding him in bed on account of the severity of the pain. While the left ureteral orifice was visible through the cystoscope, a catheter or bougie was obstructed about three-fourths of an inch from the opening. X-ray (Carman) showed shadows at this location. Operating cystoscope was then used, the dilator entering only a short distance, where it seemed obstructed. Dilatation was essayed but could not be executed to advantage until the opening had been enlarged with ureteral scissors. Dilatation was then effected and was repeated three days later, followed in two days by the voluntary passage of a ureteral stone and complete relief from pains and colics. After this there was no more obstruction to the passage of catheters up this ureter. The stone is included in the collection.

CASE 4. Ten months of symptoms; cystoscopic measures; recovery.

A. DeL——y, age 38, American, salesman, St. Louis. June 7, 1913. Attacks of renal colic began ten months ago, the first one accompanied with suppression of urine lasting a day. Cystoscopy: Right ureteral orifice healthy; left congested and inflamed; bladder excitable. Catheter obstructed three-fourths of an inch within the ureter. After using the ureteral dilator on this orifice, adrenalin solution was injected into the ureter through the catheter and the patient was sent to the hospital. Within three hours afterward a ureteral stone was passed and recovered

Fig. 9. Cystoscopic view of strictured ureteral orifice (left).

Fig. 10. Dilating sound in strictured ureter.

Fig. 11. Metal dilator in strictured ureteral orifice.

by the patient. Complete relief. Stone included in the collection.

CASE 5. Recovery after cystoscopic measures, following two years of recurrent ureteral colics of severe degree (bilateral).

F. S——r, Butler, Pennsylvania, age 59, lecturer. December 22, 1908. Patient first began having renal colics two years ago, but they have been especially severe during the past few months. Pain most intense in lower ureteral region, left side, lasting recently twelve hours, notwithstanding morphia; coincident reaction of both testes. Urine bloody. Excruciating sensitiveness of the post-urethra and bladder on attempts at instrumentation. Obstruction to both ureteral catheters; on left side at one inch above the orifice; on the right side at one and one-half inch. X-ray shadows at corresponding distances on both sides. Several successive cystoscopies were done in the following month, attended with dilatings of both ureteral orifices, attempts at grasping stones, and injection of oil, etc. While success failed at grasping the stones, the patient passed three small calculi at one time, finding them in a glass which he was required to use for voluntary urination. The finding of these was preceded by marked alleviation of the ureteral pain and improvement in the local conditions of irritation and urgent frequency, etc. And on the following ureteral catheterization (January 9) both catheters passed easily into the renal pelves. Relief from former symptoms was complete and permanent, as indicated by letters from the patient received a year later.

CASE 6. Bilateral calculi; symptoms fifteen years; relief after cystoscopic measures.

S. H——e, age 43, Sherman, Texas, attorney. Arrived October 20, 1905. Original attacks of renal colic began fifteen years ago; recurred at frequent intervals until January of the present year, since which time they have been much more frequent and severe. Sharp lancinating pain extending down the left ureteral region into the bladder and left testis, often causing the latter organ to inflame and swell (epididymitis). Large amount of morphia with the last attack of two weeks ago, which was attended with a chill and temperature of 103.5° F. Examination: Urethra hypersensitive. bleeding even after the use of a soft rubber catheter. On cystoscopy both ureteral catheters were obstructed, left at one inch and right at three-fourths inch. Ureteral dilator was used on both sides, followed by the injection of liquid albolene. Repetitions of the albolene. Repetitions of the above measures on October 30 and November 6, and all attempts at catheterization were blocked in each ureter at each of these times. Shadows also appeared in the line of the ureters on both sides. Following the essay of November 9 the patient felt ureteral colic of several hours' duration and finally sudden relief, as though something had passed into the bladder from the right ureter. Following this there was more than usual bladder irritation, until he felt something pass from the urethra included in a blood-clot. This was inadvertently thrown out by the nurse. But the indication that the stone had passed from the right side was confirmed by the easy passing, without obstruction, of a ureteral

Fig 12. Metal dilator distending ureteral orifice.

Fig. 13. Ureteral scissors engaged in strictured ureteral orifice.

Fig. 14. Effect of cutting with ureteral scissors.

Fig. 15. Stone impacted in left ureteral orifice.

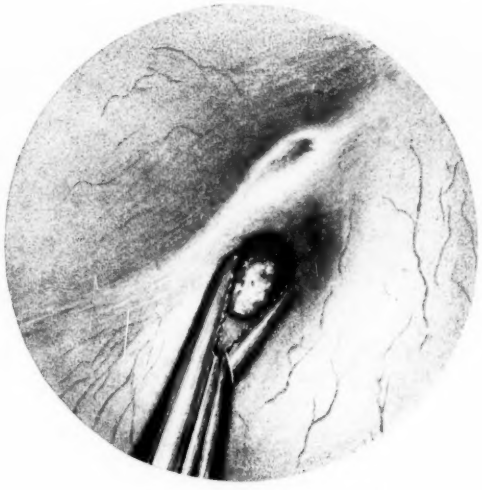

Fig. 16. Removal of stone shown in Fig. 15.

catheter, November 14, to the kidney pelvis on the right side and the absence of the X-ray shadow on that side thereafter. No colic recurred after this. The patient felt such relief that he did not wait the clearing up of the question regarding the other ureter, but went home under the promise to return in case it troubled him further. Letters from him received during the next several years indicated his continued relief from colics and urinary irritation and his enduring health.

CASE 7. Ureteral stricture and stone; recovery twice after cystoscopic measures.

I. R——r, age 36, married, Hebrew. January 26, 1911. History of ureteral colics last ten months, accompanied by bloody urine. Previous to that patient had "lame" back for a year. Urines clear but blood-cells micro scopically. Urethra tight and hypersensitive to instru ments. Cystoscopy, February 4, 1911, showed a tight stricture at the lower end of the ureter; successive sizes of ureteral bougies, Nos. 4 to 7, used. February 15 repeated. Much relief in pain and frequency in urination and other evidences of irritation. No more trouble for two years, when he returned (April 10, 1913) complaining of pain in the region of the left ureter, severe attack having begun at 3 o'clock on the previous morning. The patient was sent to St. John's Hospital, where, on the same afternoon, the metal ureteral dilator was used, stretching the left orifice vigorously. Within two hours afterward the patient passed a small stone. Complete relief came coincidently.

CASE 8. Prodromal symptoms 12 years; existing attack nine months (continuous pain); cystoscopic immediate removal; permanent recovery.

Dr. W. L. G——d, age 60, physician, Saulsbury, Tennessee. Was referred October 29, 1908, by Drs. Holder and Crisler, of Memphis. First reno-ureteral colic twelve years ago; occasional attacks since. Present attack began nine months ago and pain has been continuous since. Often the pain in the lower left ureter was so severe as to require the use of morphia. Cystoscopy showed a small black plug filling the left ureteral orifice. It was exhibited to several physicians and assistants before any measures were undertaken. Then with the operating cystoscope in place, an alligator forceps was inserted into the orifice and opened, stretching it widely. Immediately there was a spurt of pus and urine from the orifice, including with it the black plug, which proved to be a dark-colored uric acid stone with several small spiculæ that evidently had become fixed in the ureteral walls and therefore had been prevented from escaping previously. The patient at once remarked, "That is the first time I have been free from that pain in nine months." The stone was, of course, easily removed from the bladder; and the patient was at once well and has had no recurrence of the trouble.

CASE 9. Symptoms eight months; cystoscopic measures; recovery in five days.

R. B. W——y, age 30, American. March 23, 1913. History of recurrent renal colics for eight to ten months; some attacks exceedingly severe. Cystoscopy and X-ray showed obstruction in the left ureter low down (about two inches above the orifice), and also on the right side about the same distance, both shadows apparently in contact with the catheters. Argyrol solution was injected in connection with the catheter manipulations, and the patient

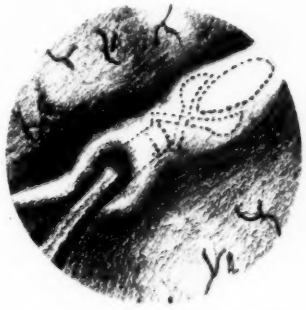

Fig. 17. Forceps grasping stone in lower ureter.

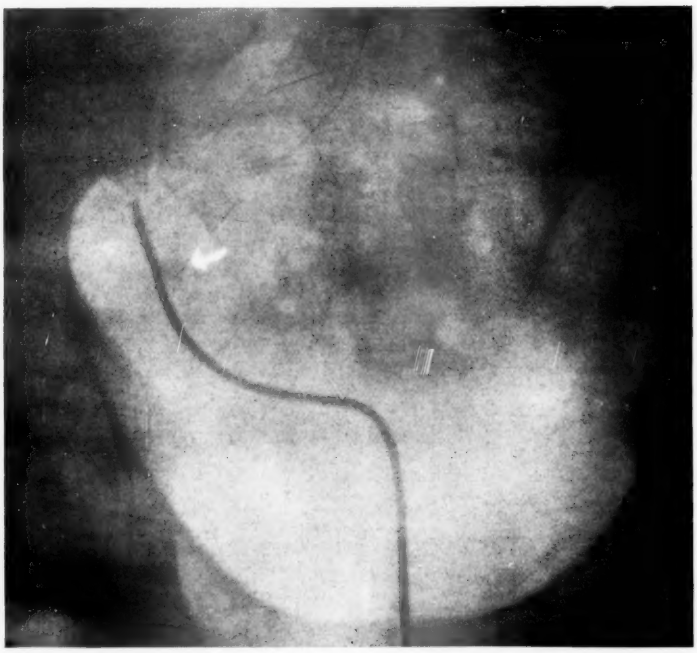

Fig. 18. Stone about three inches from lower end of right ureter; catheter in ureter. Before manipulation.

left the city for a few days. Within a week he passed a large-sized ureteral stone, relief following and lasting to the present time. He has not returned since.

CASE 10. Ureteral colic; relief through cystoscopic measures. Recurrence a year later; cystoscopic manipulations and escape of stone through abnormal opening in ureteral wall; recovery.

T. J. S——r, age 43, southern Illinois, merchant. On February 5, 1903, was suddenly stricken with a severe colicky pain in the left lumbar region, running downward along the course of the ureter into the testis. Morphia in half-grain doses gave only partial relief. On February 9, cystoscopy and ureteral catheterization were followed by forcible injections of an antiseptic solution into the left ureter. On the following night four little pieces of stone were passed voluntarily by the patient and caught in a gauze strainer; relief from pain was coincident.

Nearly a year later (December, 1903) he experienced a recurrence of the colic but did not consult me for two months, during which time there was a persistence of pain. March 1 there was obstruction to the passage of the catheter in the left ureter at about two and one-half inches above the outlet. Injection of argyrol solution, repeated two days later; but this time it was noted that the obstruction was an inch lower than at the previous catheterization. The metal dilator was then used, stretching the orifice while the instrument was being withdrawn. It was done under direct observation and occasioned nothing of moment at the time. Although the patient was instructed to use a strainer in all subsequent urinations, he failed to do this in some that were incident to the movement of the bowels. But meantime he noted relief from the colics and pain, and when the next cystoscopy was done it was noticed that two openings existed in the line of the left ureter, instead of the normal one. The extra one was located one-half inch external to the natural left orifice. A forceps or dilator, passed into the normal opening, emerged through the anomalous one, showing the communication with the ureteral channel. But on guiding it past this opening the catheter ascended without obstruction to the renal pelvis, showing the clearing of the channel of all obstructing factors. The pain was gone and did not recur. The conclusion was obvious: The stone had descended into the intramural portion of the ureter, where it had ulcerated its way through the wall into the bladder, whence it passed out in urination. No bad after-effects were observed as resulting from the unusual opening through the ureteral wall.

CASE 11. Renal colics of sixteen years' duration and extreme severity; relieved by intra-ureteric manipulations.

A. C. W——e, Jamestown, New York, age 50, lawyer. First conference, September 23, 1903. The history consisted of a recital of the greatest suffering and oft-repeated, the attacks of ureteral colic occurring while the patient was in the midst of business duties and requiring measures of the most heroic magnitude for even temporary relief. The patient's physician, Dr. Hazeltine, assured me that he had often given the patient general anæsthetics for four or five hours at a time to alleviate the pain.

The ureteral catheter was obstructed at two inches above the orifice on the right side, at the precise location of the pain as described by the patient. It drained urine

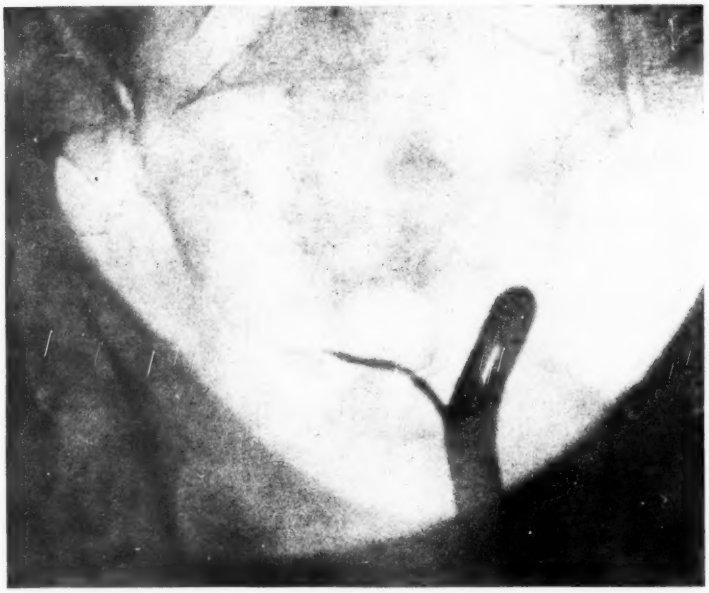

Fig. 19. Same as Fig. 18 after descent of stone, one-half inch from orifice.

that contained a definite amount of pus, non-tuberculous. Injections of antiseptic solution were made into the ureter. On two successive occasions, at weekly intervals thereafter, cystoscopy was done, and at each time it was noticed that an abnormal opening existed in the right ureteral wall at a point one-half inch above the normal orifice (similar to the condition observed in Case 10). A catheter could be seen passing under this opening in its transit upward along the ureteral channel. Relief was so marked coincidently that we interpreted the situation as relieved and the abnormal ureteral orifice as the avenue of escape for the stone. Preparations were made for the departure of the patient for home, when he suddenly had a chill, followed by a temperature of 103° and pain in the right lumbo-ureteral region. This so discouraged the patient that an open operation was insisted on and carried out, notwithstanding that the ureter was then patent to the easy passage of a catheter, as attested in a cystoscopy. Dr. T. C. Witherspoon did the operation, incising through the rectus muscle, opening and searching both intra- and extra-peritoneally, but failing to find evidence of a calculus. The ureter was found enlarged and indurated from inflammation, which doubtless was the occasion of the exacerbation of the chill and fever that had precipitated the operation.

At any rate, following this time, the catheter ascended the ureter without obstruction, and there was no more suffering from ureteral colic or pain and the patient made a complete and permanent recovery, in contradistinction to the previous sixteen years of agonizing attacks.

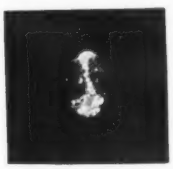

Fig. 20. Stone of Case 2 after removal. Actual size.

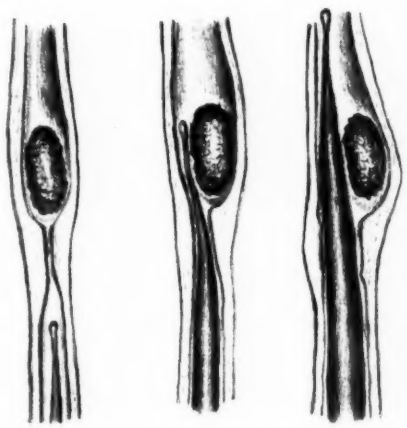

Fig. 21. Manipulation of ureteral sound when stricture and stone are located higher up in the ureter.

CASE 12. Ureteral symptoms four years; colics frequent and severe for two years; prompt relief from cystoscopic measures.

Dr. L. T——n, age 32, American, Little Rock, Arkansas. February 18, 1914. Was operated in May 1912, and 73 gall-stones were removed. Attacks of renal colic began in 1910 and have recurred from time to time since, notwithstanding the gall-bladder operation. Attacks have been very severe for the past two years, and have been more frequent latterly. March 6, 1914, cystoscopy, ureteral catheterization, and X-ray showed a stone just above the crest of the right ilium. Following dilatings and catheter manipulations liquid albolene was injected into the ureter well above the stone. This was repeated several times, and three weeks from the beginning of the maneuvers the patient passed the calculus, which was recovered and is shown in the accompanying collection of ureteral stones. Complete relief; no recurrence.

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COMPLETE DISLOCATION OF THE INNER END OF THE CLAVICLE

BY W. L. BROWN, M.D., AND C. P. BROWN, M.D., EL PASO, TEXAS

A MAN, age 33, was caught between a box car and a platform. His shoulders were forcibly crowded towards the center line, and the inner end of the left clavicle dislocated anteriorly on to the front and upper part of the sternum filling up the supraclavicular notch. This deformity was much more marked than would have been anticipated, unless one had examined the inner end of the clavicle and noticed its thickness. The dislocation could not be completely reduced, and it goes without saying that what reduction could be made would not remain.

An open operation was performed, and a horseshoe flap was made over the sternoclavicular joint, with base inward. After freeing the end of the clavicle it was found that the sternal part of the articulator cartilage was partially dislocated and would push in ahead of the end of the clavicle when it was reduced. This was caught with forceps and held in place while the reduction was being made, and it required all the force one

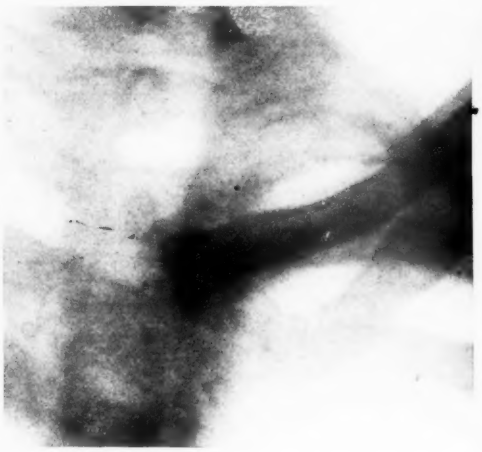

Fig. 1. Complete dislocation of inner end of left clavicle.

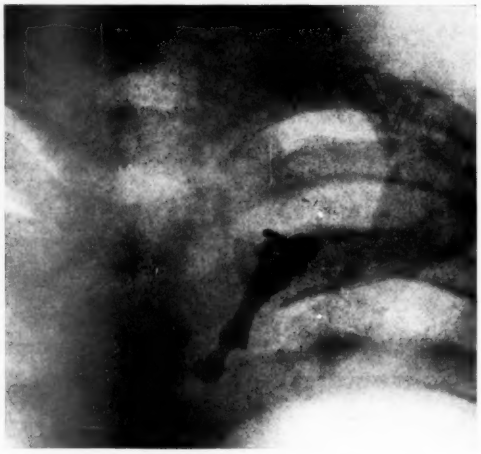

Fig. 2. Nailed and plated in place. Amount of force necessary to hold it surprisingly great.

could use with one hand and bone-holding forceps, to maintain this reduction after it was made. This demonstrated the impossibility of maintaining reduction without firm mechanical support. The tendency was to spring forward and upward. A small drill hole was made through the end of the clavicle from above, downward and inward into the sternum, and through this was driven a four-penny wire nail. This corrected the tendency to anterior displacement. It was readily seen that this would not be sufficient to prevent upward displacement but for a short time, and a light four-hole vanadium steel plate was applied diagonally from the clavicle to the sternum, the upper end being slightly hooked over the clavicle, and four small screws were used. This effectually prevented the tendency to upward displacement, this tendency being so great that it was deemed advisable to make section of the greater part of the sternomastoid muscle. Primary union and perfect anatomical result.

SURGICAL EXPERIENCES IN PUERPERAL SEPSIS[1]

By ARNOLD SCHWYZER, M.D., St. Paul, Minnesota

THE reason for choosing the subject of puerperal infection for my address before you, gentlemen, lies in the fact that it is of such great importance from the point of view not only of the obstetrician and the general practitioner but also of the serologist and the surgeon.

It would be impossible for me, and of little interest to you, to treat the subject to-night in a general and systematic way. I want to speak only of that phase of puerperal sepsis in which conservative means are no longer of any avail and where a surgical attempt becomes necessary. Since 1891 I have observed a small number of cases which, chronologically arranged, give a fairly good picture of a gradually increased aggressiveness and a gradual advance along surgical lines into this field. The fact that there are but nine cases in my series affords an opportunity of studying them somewhat in detail. It is of a certain value that the entire experience of one practice is thus portrayed instead of only a few select cases.

The general practitioner often considers puerperal fever too mystic an infection for him to grapple with. Unless the case is desperately rapidly developing secondary foci, we are sure to have somewhere in the pelvis a rather localized process, the treatment of which—let me say this right here—is not to be started with a so-called *thorough* palpation. The average gynecological examination is much too rough for these cases. If we consider that somewhere a breaking-down thrombus produced the chills in our case and that this softened thrombus is being squeezed by our examination, we ought to know that we must examine with the greatest gentleness and without producing pain. We must feel that in these cases an *exact* palpation of the pelvis is more harmful than a laparotomy in competent hands.

We, not only we, the practitioners, but also the writers of our textbooks, labor too much under the awe of a systemic infection from the beginning. Of course we will usually find a bacteræmia, but in the acute and early stages of an osteomyelitis, or even of a phlegmon or a felon, we have the same. It is hardly of any prognostic value in the early stages. If simple means, delicately applied, are of no avail and if sera do not bring help, if the case becomes the picture of outspoken puerperal sepsis, then what? A further prolonged trial with laxatives, fomentations or ice, and Crédé salve—what do they do at this stage? Painfully little, or nothing, or harm. They let us lose valuable time. Instead of fighting with time-honored but inadequate weapons or of despairingly unloading all the burden upon the shoulders of the laboratory man with his vaccines and sera, thus declaring surgery bankrupt, we should look at the case clearly and courageously. Surely we do not want to interfere surgically unless our other means are powerless in bringing on a turn for the better within reasonable time. The strictest and closest observation is therefore necessary to decide when to wait no longer.

Somewhere there was a primary entrance and somewhere it spread, mostly to a definite area. The virus has great tendency to reach the peritoneum either through the uterus or through the abdominal ends of the tubes. If this is kept in mind, large doses of salts or other laxatives are dangerous. Still the free action of the bowels is everywhere demanded, and laxatives are almost everywhere freely used. Somewhere there is a

[1] President's address read before the Minnesota Academy of Medicine, October 7, 1914.

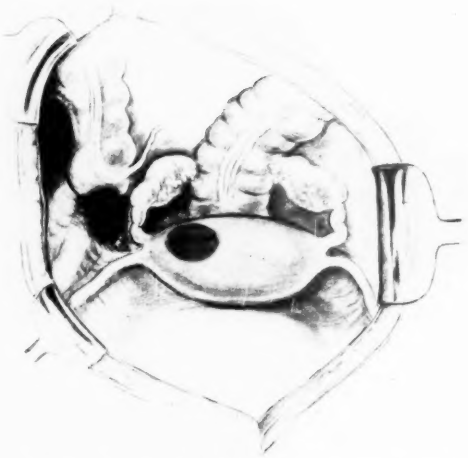

Fig. 1. Case 2. One abscess in the uterine wall; a second abscess below cæcum and a third one between abdominal wall and upper portion of cæcum.

non-mysterious focus. Mysterious it appears, because it lies deep and we, perhaps, cannot find it by palpation. Still in nearly all cases a tenderness or swelling will give some indication.

We are afraid of opening the abdomen. Why? Because we have no definite findings and because we are reluctant to add surgery of uncertain outcome to a case where we may perhaps feel somewhat guilty. Neither argument, however, ought to keep us back too long. My cases, I hope, will help to show that a local manageable condition is not infrequent.

In the hope that individual cases will illustrate certain possibilities in a clearer and more vivid manner, I will now report my small surgical experience.[1] While in my personal obstetrical work I did not have any deaths from infection or any very serious septic conditions, a number of cases of puerperal sepsis were referred to me. I remember only one case among these where surgery was to be excluded; this was on account of metastatic ulcerative endocarditis. I have, however, no record of all the cases I have seen, and thus my memory may not be exact.

The first case I saw in this country was twenty-one years ago. The attending physician considered the case hopeless. The patient made a pitiful impression and was extremely pale. She had had her child about four weeks before. The right broad ligament was thickened. The right leg was greatly swollen, presenting the picture of phlegmasia alba dolens. Her fever was above 103° and had been high for many days. The saphena I felt as a chord, and in some places there was a little reddening over the thickened vein. This indicated a severe infection of the thrombosed vein with a periphlebitis. An incision into the vein showed clear pus. Fifteen small incisions were then made on that leg, all of them liberating pus or at least a thrombus in the process of purulent softening. There was no bleeding from any one of the incisions. A change for the better occurred within twenty-four hours. The highest incision was near the entrance of the saphena into the femoral vein. I suppose that, while the patient had good warding-off power, opening the veins was very helpful in relieving the "pus under pressure," and in thus checking the upward advance of the thrombosis with the breaking down following on its heels.

This was about as simple a form of puerperal infection as you could imagine would require surgical measures. It was a puerperal septic thrombophlebitis traveling most likely from the right uterine veins to the internal iliac, then to the common iliac, and from there peripherally to the external iliac, the femoral, and the saphenous vein.

The second case was the wife of a brother practitioner. It was her third labor. After normal delivery fever had set in about four days after the child was born. It soon reached very high temperatures, up to 106°. It kept high for about a week, during which time intra-uterine douches, etc., had been given. On February 16, 1902, the case was brought to me at St. Luke's Hospital, and on February 17 we opened the abdomen by an oblique incision over a mass which we felt in the appendix region. An abscess, odorless, was found between omentum, parietal peritoneum, and the outer wall of the cæcum. It contained perhaps two to three teaspoonfuls of pus. The appendix was not connected with the abscess, was free, and looked normal. A second abscess of about the same size as the first one was then found down toward the pelvis. Again it was carefully evacuated. Finally the right horn of the uterus was reached, and this seemed soft and fluctuating. Upon incision it yielded a thick, yellow, non-odorous pus, about a teaspoonful. The right tube was found coiled behind the uterus. It was open but somewhat thickened and reddened, especially where it lay close to the subcæcal abscess. The left tube showed no marked changes. The tubes were not the principal seat of the infection, nor were their abdominal openings sealed. We thus have here an incontestable case of peritoneal infection by direct migration of the virus through the uterine walls.

Two strips of iodoform gauze were used for drainage and the wound was closed down to the drains by figure-of-8 sutures of silkworm gut. The packing was gradually removed as the temperature subsided, and on March 3, two weeks after the operation, the patient was discharged with only a slight superficial wound remaining. Since then this patient has had two children and one miscarriage.

The third case was seen in September, 1902. It was a grave form of puerperal sepsis. Eight days had elapsed since childbirth. A midwife had attended the patient, and I could get no details. Examination revealed a mass on the left side rather high up. We first incised the Douglas pouch per vaginam, but did not strike pus. The abdomen was then opened by a left-sided oblique incision, and an abscess was found on the inner side of the abdominal wall containing about two teaspoonfuls of pus. By

[1] It ought to be mentioned that I reported these cases this summer in a paper read by invitation before the Medical Society of Zurich, Switzerland. The paper was published in the Correspondenzblatt für Schweizer Ärzte, November, 1914.

blunt dissection we could gradually free a mass, which proved to be the left tube with infiltrated walls and of the size of the index finger. The tube was removed. The ovary was large and covered with fibrin, but was left undisturbed. The broad ligament, much swollen and œdematous, was incised, and showed purulent infiltration between its layers. The whole area was walled off by four gauze strips.

These are the notes made at the time. To-day I might have added ligation of the veins, internal iliac and ovarian, but at that time we were not so much aware of the power of localizing these processes by venous ligation. The "purulent infiltration" of the broad ligament may have been breaking-down veins. The memory cannot decide that.

In the night following the operation our patient became delirious. Gradually the neck showed rigidity, until five days after the operation, i.e., thirteen days after childbirth, she died of septic meningitis, September 18, 1902.

CASES 4 and 5. I had two cases of beginning diffuse peritonitis due to perforation of the uterus during labor. The first one happened while I was assistant at the Zurich University Hospital for Women. The case was reported in the Correspondenzblatt für Schweizer Ärzte in 1891 by Professor Wyder, together with a similar case of his own, and was declared to be the first case on record of surgically treated puerperal diffuse peritonitis with recovery. As it greatly resembles my second case, which occurred at St. Joseph's Hospital on March 25, 1908, I shall describe the latter and mention the former only where it differs.

This second patient, a small woman of 30 years, was to have her first child. The labor was protracted, and when her physician arrived and examined her he found a forehead presentation. Attempts were made to change the position, but when the physician was at the end of his strength he called in a colleague, who again attempted to turn the child. This second physician found the uterus greatly contracted, and in his attempts he noticed that he grasped a handful of the mother's intestines, just as the policlinical assistant had felt in my first. The diagnosis of perforation of the uterus was made and the case brought to St. Paul. The patient looked somewhat cyanosed, the abdomen was bloated, rather rigid and moderately sore. The temperature was $103^{2}/_{5}°$; the pulse 148. The external genitalia were swollen and bruised. The child was dead for over a day. It was, of course, important not to disturb the relation of things in removing the child. The vulva, vagina, cervix, and presenting portion of the child were to be considered as grossly infected. The area of the uterine tear was not to be trusted in any way. The skull of the child was opened, the cranioclast fitted over the orbit, and the child delivered. Examination after removal of the placenta now revealed a large tear in the abdominal cavity apparently through the lowermost portion of the thin cervix posteriorly. Through this tear the obstetrician's hand must have entered. There were no intestines lying in the tear. It seemed best to inspect the condition by laparotomy, which followed immediately, at 5 P.M., March 25, 1908. A large quantity of dirty brown, flaky material was mopped out of the lower half of the abdomen. There was no odor, however. The uterus and the intestines in the neighborhood were greatly reddened. The peritoneum of the urinary bladder was black and a large hæmatoma existed

Fig. 2. Case 7. Diffuse seropurulent peritonitic exudate. Abscess in wall of uterus; acute salpingitis; ovarian tumor.

in its wall. The black torn edges of the perforation in Douglas' pouch were left as they were. A large drain was inserted through the tear into the vagina. A gauze drain was also left in the lower end of the abdominal incision. The next forenoon the pulse was 140, the temperature 103°. The urine was bloody. Catheterization was necessary. Streptolytic serum (20 ccm.) were given during the day. In the evening the temperature was 99°, the pulse 122. The patient left the hospital in good condition eighteen days after her admission.

In my Zurich case, which I mentioned before, the tear was in front of the uterus; the peritoneum was torn and bruised for a stretch of 15 cm. The uterus and the adjoining intestines were highly reddened; the patient's temperature was about 103°. Flaky, turbid material was washed out of the abdomen with a solution of salicylic acid (1:1000). No drain through the tear was employed, but the whole area of the tear was inverted with two rows of interrupted sutures, reinforced in places by a third row. The uterine cavity was then washed out. On my first visit back to Europe I was informed that my patient had come again to the hospital some two years later and had gone through an entirely normal non-instrumental childbirth.

It will be noticed that the lucky outcome in both cases was principally due to the fact that they came to operation in a very early stage of the peritonitis.

CASE 6. Occasionally we may get a picture of puerperal sepsis with a peritonitic suppuration in one confluent cavity in the pelvis. If rapidity of the development, fever, and general condition indicate a very virulent infection, it must be best in any case first to evacuate the pus by a vaginal incision in order to avoid soiling the abdomen, even if we find that we have to open the abdomen at the same session. We thus have a wide drainage-opening and can operate much cleaner from above. Occasionally,

Fig. 3. Case 8. Gangrenous placental area of uterus. Septic metritis. Purulent thrombophlebitis of right ovarian and uterine veins.

though rather rarely, the vaginal incision may suffice, if no secondary abscesses or large thickenings can be palpated after the evacuation. One such case we had in March, 1900. The patient, a very large woman, was referred to us about three weeks after childbirth. There was an enormous bloating of the abdomen. On the day of admission, March 11, the temperature stood at 103°. On the following days it reached 102°, until on March 16 we incised the cul-de-sac, after which the temperature was normal, and the patient was discharged on March 23.

Here the puerperal infection resolved itself in a large single pelvic abscess, though the appearance of the patient, the great soreness and pain, with the excessive bloating of the abdomen, presented a clinical picture causing great anxiety.

Case 7. Mrs. H. A. R., 26 years old, was sent to St Joseph's Hospital from the country on January 26, 1911. She had been delivered a week previously and promptly after that had a high temperature, bloated, had abdominal pain and soreness. On arrival at St. Joseph's Hospital in the evening her temperature was 102⅖°, pulse 150; her condition looked grave. There was apparently no diffuse peritonitis. To the right of the still large uterus a swelling could be made out, which was very sore. We decided to operate that same evening. A median incision was made. Free seropus was found in the abdomen. The right tube was œdematous and thickened. The right ovary formed a cystic tumor the size of an orange, adherent in the lower portions. Tumor and tube were removed. The uterus was a little larger than a man's fist, reddened, doughy, œdematous. Near the right horn of the uterus, toward the anterior surface, there was a bulky, raised, fluctuating area, about 2½ to 3 cm. in diameter. This was opened, and thick yellow pus escaped from an intramural abscess. An iodoform gauze drain was placed into the opening. The patient was put to bed and proctoclysis started. During the night and the next morning the pulse was 140 and the temperature 104°, but by evening it came down to 100⅘°, with 108 pulse. While the temperature never reached a high degree, it was more than two weeks before it permanently stayed below 100°. This was due partly at least to an abscess in the breast, which was lanced on February 16, after which the patient was able to be out of bed. She went home in good condition on February 23, four weeks after entering the hospital. Since then the patient has had one miscarriage. She feels well.

Perhaps the most interesting one of my cases of puerperal infection was the following one:

Case 8. The patient, a farmer's wife, 33 years old, had had 3 previous childbirths. On June 13, 1912, she had a very difficult instrumental delivery and gave birth to triplets. The first one necessitated forceps and lived; the second one, brought to the world three hours later by apparently a very difficult version, was dead. The third one, also dead, was likewise delivered by version. All three children were large. The placenta was scraped off its lodge under great difficulty. The uterus was irrigated after that with corrosive sublimate solution. The day after the delivery the temperature went up to 104°, the pulse to 120, and her physician administered polyvalent antistreptococcus serum three times daily for five days without any benefit. Eight days after her delivery she was put on the train and sent to St. Joseph's Hospital. Her temperature was 105⅕° on her arrival, her pulse 140.

For inspection of the condition she was taken to the operating room, and by a very gentle, palpating blunt curetting it was found that there was no retention of placenta or placental thrombi. The uterus was irrigated and a gauze strip, saturated with carbol-camphor (carbolic acid 30 per cent, camphor 60 per cent, alcohol 10 per cent), was inserted. The temperature, though still 103⅖° the next forenoon, under repeated irrigation and renewed insertion of iodoform gauze strips saturated with carbol-camphor became more reasonable, so that from the afternoon of June 22, till early morning of June 28, it ranged from 100° to 101⅕°, a few times even striking the 99° mark in the morning. Nevertheless, by noon on June 28 the temperature was up to 103⅖° and on the next day it was around 104° most of the time. On June 30 she had a chill lasting eight minutes, and the temperature reached 105⅖°. It became plain that we were going to lose our patient if nothing definite could be done. Even on June 27, two weeks after the delivery, the fundus still stood 8 cm. above the symphysis and only 4 cm. below the navel. The uterus was bulky, no definite exudate could be felt on palpation, but the palpation had, of course, to be very gentle. We judged that the placental area and the uterus were the main seat of the trouble; the chill with lack of a bulky exudate told us that somewhere a broken-down thrombus was to be reckoned with, while the rather steady high fever indicated at the same time constant lymphatic absorption. The case looked desperate, and if we wanted to risk a surgical attempt, no time could be lost. It looked as though we had waited too long. We decided to open the abdomen and in case of negative findings to remove the large uterus anyway. This was done by a median incision in the forenoon of July 1. The

uterus was very large, doughy, and reddened. From the somewhat diffusely thickened right broad ligament a hard chord, which corresponded with the right ovarian vessels, was felt running retroperitoneally over the linea innominata clear up to the kidney region. In the region of the linea innominata it had the thickness of the handle of an ordinary carpenter's hammer. It became less bulky farther up. We removed the uterus with the adnexa supravaginally and drained widely through Douglas' pouch. Then we did something which I am not decided whether I shall do a next time or not, as it turned out to be more traumatism than it at first appeared to be. Starting at the right edge of our abdominal incision we detached the peritoneum from the remainder of the abdominal wall until we were behind the ascending colon. Thus we reached the mentioned hard, chordlike mass. It proved to be the thrombosed ovarian veins. The surrounding infiltrated arealor tissue and the vein were opened as far upward as possible. This was near the lower pole of the kidney, where the veins are gathered into one. No bleeding occurred. The ureter was not discernible. The patient's condition was none too good, and it seemed risky to manipulate these purulent breaking-down thrombi any further. A gauze drain, saturated with carbol-camphor, was put over the opened area and led out through a lumbar stab wound. The peritoneum was then allowed to fall back into place and the abdomen was closed. The operation had consumed sixty-five minutes; the pulse after the operation was 120, and twelve hours after the operation had gone down even to 96, with a temperature of $100^{2}/_{5}°$.

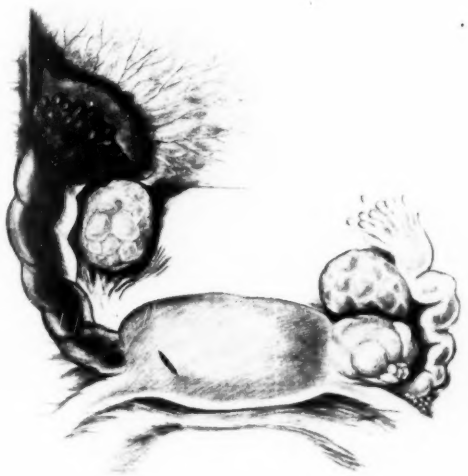

Fig. 4. Case 9. Right-sided acute pyosalpinx. Tubo-abdominal abscess. Purulent thrombophlebitis of right ovarian vein. Left-sided small intraperitoneal abscess.

The favorable outcome in this case proves that we need not feel as anxious to "get in quick and get out quicker," as we do in diffuse peritonitic conditions, but rather to consider the time of less importance, holding foremost in our mind the duty of surveying all the pathology, so as not to overlook abscesses or thrombosed vessels. This I consider an important point. With experience we shall not tackle entirely hopeless cases, but shall make it a point to go more fearlessly at a thorough investigation, where the general condition is not too advanced. The thoroughness is more important and the patients stand a fair sized opening of the abdomen quite well. It is, of course, of utmost importance that we do not soil our wound and the peritoneum more than is absolutely necessary. This can be better accomplished by a sufficiently large incision. In closing such abdomina silkworm is by far the best suture material. We avoid even fine catgut as much as possible; it makes too readily a culture medium.

To return to our case: The uterus, on opening after its removal, showed a green, sloughy placental area. On the day following the operation the temperature reached only $101^{2}/_{5}°$, and on the next day not more than $100^{2}/_{5}°$. But alas, we were not at the end of our troubles. On the evening of July 4 the temperature rose again. There was a very offensive odor to the vaginal discharge. On July 5 considerable pain was felt in the right leg and the right groin; the temperature crept up to $103^{2}/_{5}°$. During the following two days the condition remained about the same, while on the evening of July 8 a severe chill, lasting forty-five minutes, came on followed by an axillary temperature of $104^{3}/_{5}°$, and a pulse of 126. Four hours later (at midnight) another chill, lasting twenty-five minutes, came on, and this time the temperature was 106°, and soon later $107^{2}/_{5}°$, even, by axillary measurement. The pulse became weak and was counted 152 per minute. The patient was nauseated. Under another slight chill two hours later the temperature still remained at 106°. Four hours afterward, at 6 A.M., it dropped to $99^{3}/_{5}°$. In the afternoon it crept up again, and after a chill at 9 P.M. the temperature was again, by axilla, 107°, with 148 pulse. Antistreptococcus serum was repeatedly given without apparent influence. Again a drop followed toward morning of July 10 to $98^{3}/_{5}°$ per rectum, with 110 pulse, while the afternoon brought another chill with $104^{4}/_{5}°$ by axilla, and 152 pulse. I mention these great variations in temperature somewhat in detail, because they make a perfect picture of the thrombophlebitic type of sepsis. Each time when the purulent melting of a venous thrombus reaches the end of the thrombus, and instead of being blocked by further clotting empties itself into the free circulating blood, we have a chill and a sudden onset of high fever, which may be followed by a renewed local clotting and sealing.

In our case we knew that the ovarian veins were having a reasonable chance to unload themselves by way of the drain. But were not the uterine veins at the bottom of these new chills? We mentioned above pain in the right leg and the right groin. We had used a simple continuous catgut for the bed of the excised uterus and adnexa. In about ten days we could hope it would be absorbed, and thus we would have a chance that the pressure in the internal iliac venous tree would be released by the opening of the lumina of the cut veins. At any rate renewed operative interference appeared reckless. Was it a better discharge through our dorsal drain, or was it the giving

away of the catgut in the pelvic wound, or was it principally a favorable fate in the form of great immunizing power of the patient? At any rate on July 11, the eleventh day after the operation, the temperature remained more moderate. It rose only to 102⅘°. On July 12 the temperature ranged between 98⅖° and 100°. On the following day the patient was allowed to sit up in a chair on account of a sore back. On July 26 I find the first note that the patient was allowed to walk about, and on July 30 she went home. The recovery then progressed without further trouble. A year and a half later, in January, 1914, upon my request she came to St. Paul for control. My notes of that date read: "She is well, though at times a little weak; she does her housework, and, while before her sickness her usual weight was 135 pounds, she now weighs 158."

In this case, as in abdominal hysterectomy for inflammatory and fibroid conditions, we removed the uterus after clamping the broad ligaments on both sides. It would then have been better to do as we did in the case that is to follow; i.e., not to ligate or suture over the clamps, but to remove first the clamps one by one and to grasp only the bleeding vessels individually with fine artery forceps for ligating. The more extensively the broad ligament is thrombosed, the more desirable it becomes to catch only the bleeding vessels and to leave wide open all thrombosed ones.

Case 9. Mrs. P. G. had a normal labor. The child was born before her physician arrived, on January 3, 1913. The afterbirth came away easily and complete. There was a slight tear, which the doctor repaired with three stitches. On the third day everything was normal. On the fourth day she began to complain of headache and was not feeling very well from then on. On the sixth day her physician saw her again and found the temperature 100½° in the afternoon, and the pulse over 100. She had a pain in her side and a slight enlargement. There was tenderness in the right iliac side. After about four days the temperature rose to 103°, and on January 20 (seventeen days after her labor) she had a severe chill followed by fever of 104°, with a pulse of 110. The following afternoon she was sent to St. Paul.

There was much bloating of the abdomen and soreness on the right side of the lower abdomen, where a very tender though not very distinct mass was felt. The uterus was not abnormally large for the time elapsed since the delivery. It was found not to contain any abnormal remains on very gentle blunt curretting, nor did we notice a foul discharge. The uterus was fixed in moderate dextroretroversion. On January 21 I dictated: "From the position of the uterus and the chills and intermittent fever we have to diagnose a thrombophlebitic sepsis, located especially in the right uterine and right ovarian veins." The highest temperature on January 21, the day of her arrival, was 103⅕°, and on the following day 103⅘°, with 118 pulse. The rectum was found impacted, and after an enema the patient felt much better. Nevertheless, on January 23 the temperature, after having been 98⅗° in the morning, reached again 103⅖° for several hours. The next morning, after a good night, it measured 97⅗° by axilla, but in the afternoon, following a chill of twenty minutes' duration, it went up to 104 1/10°.

On January 25 the abdomen was opened. The bowels were found greatly ballooned. The uterus, doughy, containing a small fibroid, is fixed toward the right, where the tube is found very much thickened and an abscess is opened while we try to detach some infiltrated omentum from it. This abscess has as an outer wall the peritoneum of the iliac fossa. The mesosalpinx is infiltrated, and this thickening reaches in the infundibulopelvic fold backward to the area of the common iliac vessels. The appendix, found acutely reddened and fixed to the tube, is removed. On clamping the uterine end of the tube some pus wells out at the site of the clamp. On clamping off the tube from the ovary, which we first intended to leave, the ovary is found friable and suspiciously juicy, so that it is decided to remove it. On clamping the ovarian vessels behind the ovary pus again oozes out from the clamped area (veins?). After the adnexa are cut away, the mesosalpinx is united with a fine running catgut to the outer third. Now, in order to find the extent of the suppuration along the ovarian vessels we release the clamp before sewing. However, no pus comes forth, nor can any be milked out from above. The uterus is very doughy and soft near its right horn, and a stab wound is made there to see if we could strike pus. No pus shows, however. In freeing the left adnexa a small abscess with a few drops of pus appears near the uterine horn. To be as safe as possible the posterior peritoneum is then divided over the left common iliac area. The ovarian vein, though it shows no sign of thickening at that point, is ligated. One fine suture reunites the peritoneum over it. After this the Douglas is widely opened over a curved clamp previously inserted into the vagina. A tube and gauze drain are thus pulled down through the opening into the vagina, while above a rubber dam and gauze drain are inserted into the right iliac fossa through a stab wound. This drains the abscess.

The temperature never rose very high after the operation. On the third day it reached 101°. There were no more chills. Five days after the operation the temperature was 100° in the afternoon. On February 4 the abdominal, and on the following day the vaginal, drains were removed. On February 14, one day less than three weeks after the operation, our patient went to her home in Wisconsin. She is reported by her physician as well.

This finishes our series. I should have liked to add a case of a man who was sent to me as a cryptogenetic sepsis, with temperatures over 106°, where the ligation of the internal iliac vein saved our patient from sepsis originating in the vesicoprostatic plexus. This would lead us, however, away from the subject of puerperal sepsis. I shall report the case soon under a separate heading. To summarize our findings, we had in

Case 1. A severe purulent thrombophlebitis.

Case 2. Severe sepsis. One abscess in the wall of the fundus uteri and two separate intra-abdominal abscesses.

Case 3. Intraperitoneal abscess; pyosalpinx; suppuration in broad ligament; meningitis; death.

Cases 4 and 5. Beginning diffuse peritonitis after perforation of uterus.

Case 6. Large pelvic abscess.

Case 7. Diffuse seropurulent peritonitic exudate; acute salpingitis; ovarian tumor; abscess in the wall of the fundus uteri.

Case 8. Severe infection of placental area of uterus; purulent thrombophlebitis of right ovarian and uterine veins; extirpation of uterus; opening and draining of ovarian vein.

Case 9. Right-sided acute pyosalpinx; tubo-abdominal abscess; purulent thrombophlebitis of right ovarian vein; left-sided intra-abdominal abscess; drainage of right ovarian vein and ligation of left ovarian vein.

The more we find localized changes in a case, the more definitely it becomes surgical. Our plea, however, is not to wait for the moment when by overwhelming proof we might be forced to use the knife, but in each case where the symptoms become alarming to watch for the time when surgery can do good, and not let that moment slip by. Only practical experience, to be sure, can teach us in difficult cases where surgery would be inadvisable or where waiting would mean defeat.

European literature is very lukewarm as to surgical interference, and in general so is our own, notwithstanding the fact that Hirst of Philadelphia has reported most remarkable results.

Before closing I should like to emphasize the importance of Trendelenburg's ligation of the veins. This was a truly great step ahead. This blocking of the venous infection should not be done, it seems to me, without opening the peritoneal cavity or without a sufficient investigation of the whole condition. It ought to be combined with whatsoever other surgical measures become necessary. In opening and draining the infected veins, if the condition calls for it, we obviate the objections of one of our recent American writers, that Trendelenburg's operation only locks up the thief, but does not dispose of him.

Our cases illustrate that each one is a problem for itself, just as would be the case in a pyogenic infection in a complex part of the body. We have a widespread raw surface after childbirth and any pyogenic germ may produce trouble as soon as it is given a chance. Puerperal infection, like a pyogenic infection in any part of the body, may better be treated conservatively under certain conditions or for a certain length of time, but it must be treated with a view to surgical intervention and with surgical knowledge.

PROSTATECTOMY UNDER LOCAL ANÆSTHESIA[1]

By CARROLL W. ALLEN, M.D., New Orleans

IN the operative relief of hypertrophy of the prostate we have, in the great majority of cases, to consider certain factors which are not, as a rule, involved in other surgical procedures; namely, those of age, as most of the cases requiring surgical relief for this condition have reached or passed middle age, and many of them are infirm or weakened by suffering and infection. In the old and feeble, prostatectomy is a formidable operation, though not attended by a greater mortality than that following any other major operation in the same class of patients. However, it may even show a more favorable comparison by observing certain methods in the handling of these cases.

Surgical technique has reached such a stage of perfection that in the more commonly performed operations it would seem difficult to suggest improvements in the recognized methods of procedure in typical cases. Improvements will come, but I believe that they will be more in the preparatory treatment, general handling of the case, and refinement in details, rather than in the general principles involved in the operation. One of the notable advances recently introduced as a general surgical procedure is the anoci-association of Crile. This I believe to be a factor of great consequence, particularly when applied in old and feeble patients, as it prevents shock-producing impressions from the field of operation from reaching the higher nerve-centers.

The method which I wish to present today is the result of a process of gradual evolution and improvement in handling these cases. Beginning with the two-stage operation and the adoption of the anoci-association principles to control shock, and the logical addition of adrenalin for the control of hæmorrhage, it has gradually progressed to the point of complete elimination of all general anæsthetics, which are now never necessary, but which, however, should be preferred in undoubted malignancy of the prostate in which methods of infiltration should be avoided.

The two great factors in the production of shock are trauma and hæmorrhage and to these,

[1] Read before the Southern Surgical and Gynecological Association, Asheville, North Carolina, December, 1914.

in the great majority of surgical procedures, is added that of the general anæsthetic. In the recent more improved methods of general anæsthesia this may be practically eliminated as a shock-producing factor, yet it nevertheless has its dangers in the deranged stomach, possible pulmonary and, particularly in prostatectomy, renal complications.

These cases present another danger fully as great as any of the above which I believe is responsible for a large proportion of the mortality in these patients, a danger peculiar to these cases.

Few patients requiring prostatectomy present themselves for operation before they have seriously felt the inconvenience of this condition, many have probably already been initiated into catheter life, some have had one or more attacks of acute retention of urine from prostatic congestion, and practically all will show considerable residual urine and possibly some renal complications; nearly all are disturbed frequently at night by having to arise to urinate. The kidneys have gradually accustomed themselves to this condition and are working against considerable back pressure, and the sudden relief of this pressure at operation completely upsets the renal equilibrium leading to congestion with diminished excretion, or probably anuria. Here lies the particular danger in these cases, and to avoid it we must first relieve the bladder and permit the kidneys to recover by performing these operations in at least two stages in all cases that show much residual urine or are suffering from retention at the time of operation. The danger, too, of suddenly relieving a distended bladder in these cases cannot be overestimated; vesical hæmorrhage may occur associated with renal suppression. In my observation, this procedure alone has caused as great a mortality as prostatectomy.

In extreme cases such bladders should never be opened at once, unless badly infected and the danger of general infection too great for delay. They should be gradually evacuated by catheter, removing but a portion of the urine at a time at two- or three-hour intervals, or if almost completely emptied one-fourth to one-third as much boric acid solution reinjected as there was urine removed. This gradual emptying process should consume from twenty-four to forty-eight hours before the bladder is opened.

Rarely a case is met with in which there is considerable distention and the passage of a catheter too painful, difficult, or even impossible of accomplishment. In such cases, if the suprapubic incision is carried down to the bladder, the bladder can then be emptied by a gradual process of aspiration at intervals of several hours, gradually withdrawing more and more at each successive aspiration, thus overcoming the difficulty. During these intervals the suprapubic wound is kept packed. After twenty-four or forty-eight hours the bladder, which is now fairly collapsed, can be opened with safety.

The method of performing the cystotomy and of dealing with the bladder afterwards is of some consequence. It may be opened with a free incision with the introduction of a tube or catheter to its base and the attachment of some syphoning apparatus, or the escape of urine may be effectively controlled by making a small buttonhole opening into which is passed a Pesser catheter. The incision is then infolded and held by two stitches, one placed on either side of the catheter. Such a valvelike closure will leak very little, if at all.

The advantage of this last method is quite apparent, as it permits the collection of all urine and in this way the functional activity of the kidneys can be accurately gauged. It will usually be found that the urinary excretion for the first two days diminishes considerably following the cystotomy, gradually increasing from the third to the fifth day, and is about normal by the end of the first week. By this time, if the patient's general condition is good as shown by normal appetite with good digestion, free bowel movements and after a few nights' normal restful sleep, free from the annoyance of frequent urinations, the removal of the prostate can be undertaken.

If any question exists regarding the condition of the kidneys a further delay is necessary, or their capacity may be tested by phenolsulphonephthalein, and under no conditions should the prostatectomy be attempted until they have reached a fairly normal condition of elimination. By handling patients in this way many bad risks and feeble individuals may be safely carried through the surgical ordeal.

During the interval between the suprapubic cystotomy and the prostatectomy the bladder should be washed once or more daily with warm boracic solution and the suprapubic wound kept lightly packed, and any infection in the cellular planes which may have occurred, which, however, is rare, should be well under control before the final operation is attempted. It is usually noticed that the prostate diminishes decidedly in size following the cystotomy due to the relief of the congestion and this diminution in size facilitates its later removal.

For the suprapubic cystotomy the bladder is

first irrigated freely through a catheter with boracic acid solution and left moderately distended.

The injection of the field with the local anæsthetic solution is preferably completed before the incision is made, infiltrating the skin and subcutaneous tissues in the middle line for a distance of three or four inches and then passing a long fine needle down through the skin to the anterior rectal sheath. This sheath is recognized as the first plane of resistance which the needle encounters after the skin is passed. The sheath is gently penetrated, injecting, as the needle is advanced, for about one-half to one inch further, and the interval between the recti infiltrated. This procedure is repeated at several points along the proposed line of incision. Near the pubis the injection is carried a little deeper into the prevesical space, always injecting as the needle is advanced. If any uncertainty is felt regarding this last deep injection it can be omitted until the recti are separated and the deeper parts brought into view.

After the incision the parts are gently retracted, progressively advancing until the bladder is reached; the cellular tissue over it is divided and pushed up with the peritoneum out of the danger zone. In making this suprapubic incision it is advisable not to approach too closely to the pubis but to keep one or two inches away from this point — the distance depending upon the size of the bladder — and yet the incision must not be too close to the peritoneum. This method has the advantage of avoiding the possible danger of suppuration in this space and facilitates the more rapid closure later of the fistulous opening, for the nearer these openings are to the peritoneal reflection, the quicker seems to be their closure. Those suprapubic fistulæ which have been difficult to close have always been close to the pubes.

The superior bladder-wall is not, as a rule, very sensitive but it should be lightly infiltrated before being incised—one stitch on each side fixes the upper part of the bladder to the posterior rectal sheath; the bladder is then freely irrigated and its cavity explored determining the size and shape of the intravesical projection of the prostate, removing calculi should they exist, and obtaining any other information which may be necessary. If a direct visual inspection is desired in cases in which complications are suspected, this can be easily accomplished by evacuating the contents of the bladder and by placing the patient in the Trendelenburg position. Air will enter and dilate the bladder and its interior can thus be freely inspected by gently retracting the incision. Or, if preferred, a short proctoscope with light attached may be passed within the cavity.

If much intravesical examination is necessary or it is desirable to examine the vesical cavity digitally, some form of intravesical anæsthesia then becomes necessary. For this purpose I have found it both inadvisable and unnecessary, as well as ineffective, to attempt to anæsthetize

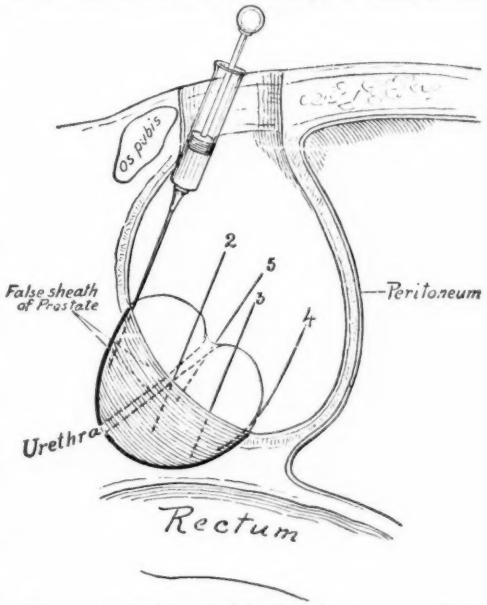

Fig. 1. Author's method for injecting prostate: Lines 1–3 indicate points for injection above and on side of prostate; 4, beneath prostate—this may at times be more conveniently made by a curved needle; 5, enters urethral opening, penetrates urethra, and is made between lobes of gland. While the lines show the axis of the injections with the prostate lying normally in its bed when the injections are made, the prostate is lifted up by a finger in the rectum, so that the needle can be more readily entered in the proper position through the suprapubic opening.

the interior of the bladder for cystotomy and suprapubic manipulations within it by filling it a short time before with anæsthetic solutions. This procedure is now resorted to only for cystoscopy. For all manipulations and operations within it, direct injections are made into, or around, the field to be operated.

The particular sensation with which the bladder is endowed and which is felt upon any abnormal contact with its walls, either internally or externally, is that feeling which we term the desire

to urinate. This feeling is more easily excited by manipulation from within and always more acutely toward the vesical neck and prostate region. Pain is only complained of when these manipulations have been rough or when actual trauma has been inflicted. The introduction of a finger within the bladder for purposes of exploration excites a desire to urinate and this desire may become particularly urgent and always becomes so when the parts near the vesical neck are touched. It is not a pain but still may be quite unbearable and demands some effective method to control it. This is accomplished in but a few moments of time. The bladder is first well irrigated and then emptied; with the patient in the Trendelenburg position to dilate the cavity and bring its base into plain view, the anæsthetic solution is injected with a long, fine needle at four or five points around the vesical neck, injecting about one-half dram at each point. The needle is advanced just through the mucous membrane with a quick thrust, injecting the solution as the needle is advanced. Unlike the skin and most other tissues the bladder is tardy in recording its sensations and anæsthesia results before any sensation is felt from the punctures. Ordinarily these injections around the vesical neck are sufficient for all intravesical manipulations, which can now be undertaken with the greatest freedom. However, in complicating conditions where the lateral walls are to be operated upon, further infiltration around the field becomes necessary. But as most nerves reach the bladder near its base and around the vesical neck, the injections made here are most effective in controlling its sensation.

If the case is one that does not come within the class requiring a two-stage operation but the patient is in fairly good physical condition with good kidneys and with but little residual urine and no bladder infection, the prostate may be anæsthetized and removed at once.

Whether this be done in a one- or two-stage operation, certain preparatory measures are advisable. One hour before operation a suppository containing 10 gr. of anæsthesin is placed in the rectum to anæsthetize this region and prevent any discomfort when the finger is introduced here in elevating the prostate; at the same time, one hour before operation, a hypodermic of morphin 1/6 gr. and scopolamin 1/150 gr. is administered to lessen psychical disturbances.

If the case is one in which a cystotomy has previously been done, the Pesser catheter or tube is removed from the suprapubic opening. The wound is found presenting a granular surface sloping down toward the vesical opening. This is most effectively and quickly anæsthetized by passing a fine needle through this granular surface and injecting just beyond. By beginning these injections above under the skin margin, the needle can be advanced obliquely in several directions creating a zone of anæsthesia just external to this wall of granulation tissue which will diffuse in all directions, blocking nerve-fibers which come into the field. This is done on both sides and carried down to the vesical opening. Injections are similarly made above and below the limits of the wound in the subcutaneous tissues in the median line, as the wound has probably contracted and will have to be enlarged. The passage of a fine needle through this granulation tissue causes no pain and for that reason is preferred to passing the needle from the skin down. A finger is passed into the bladder to outline its upper limits and determine the proximity of the peritoneal cavity above. Additional injections are now made into the upper wall of the bladder with the finger within guiding the point of the needle.

The bladder opening is enlarged and the patient placed in a moderate Trendelenburg position. After the bladder is well irrigated and emptied, either with a large syringe or sponges, its walls are then retracted by long, deep, narrow retractors, bringing into view the field of the prostate. Depending upon the size and shape of the prostate, several points are selected for injection on the vesical surface, usually one below the opening of the urethra, near the base of the gland, and one on either side. The needle is passed through the mucosa, with the idea of making the injection between the true and false sheath of the prostate, as it is in this plane that the solution must diffuse around the gland, and it is in this plane that its enucleation is effected. It is here where the large venous plexuses are situated and where the nerve-filaments are more easily reached as they pass through to the prostate.

Two or three drams of a ½ per cent novocaine solution, containing 10 minims of adrenalin to the ounce, are injected at each of the above points. The needle is then passed into the urethral opening and the lateral wall pierced first on one side and then on the other, and similar injections are made at these points. During these injections the finger is kept within the rectum to better guide the passage of the needle around the prostate where its point can be felt passing between the gland and its false capsule;

it also facilitates these injections by elevating or manipulating the gland and guards against the penetration of the false capsule by the needle.

If the gland is very large, or there is much of a projection above the urethral opening, an additional injection can be made here. Otherwise the above will prove sufficient. It is well now to wait two or three minutes for the solution to diffuse and thorough anæsthesia to be established before beginning the enucleation. While waiting for the solution to diffuse, the action of the adrenalin is observed in the prostate, which becomes quite pale and bloodless.

In making the injections, should they be made into the substance of the gland itself no harm will be done, only they are not quite as effective as when injected peripherally between the true and false sheath; any excess of the solution thrown into the gland in this way is removed during its enucleation and not absorbed. Following these injections a catheter is passed into the bladder. The enucleation of the gland can now be undertaken by any method preferred by the operator and will be absolutely free from all pain or other discomfort. If the intra-urethral method is chosen the passage of the catheter can be omitted until later, but I have always found its presence a convenient guide to the location of the urethra during the different stages of the operation. A most striking feature is the absence of all bleeding, only a few sponges being slightly soiled, the loss of blood amounting to not more than one or two drams at most. There is no blood to swab out of the bladder afterward.

The catheter which has been left in the urethra is now utilized to draw through the urethra, from the bladder outward, a stout piece of silk which has been doubled and passed through a plug or pad of iodoform gauze arranged somewhat cone-shape and about the size of the cavity left by the removed gland. The silk thread is long enough to reach beyond the glans penis and when pulled upon draws this plug effectively into the cavity thus insuring against any possible secondary hæmorrhage. The plug in passing into the cavity also has the effect of turning in any free edge or shreds of mucous membrane against the raw surface of the capsule. One end of the pack is left long enough to protrude through the suprapubic opening to facilitate its removal later. This is a most effective and simple method of providing against possible secondary hæmorrhage, which is impossible when the pack has been properly placed. As the pack is entirely under your control, it can be forced in tighter by drawing upon the urethral string, or loosened by manipulating the suprapubic end. For this valuable procedure I am indebted to Professor Matas, who taught me its use.

A drainage tube placed in the suprapubic opening and a few approximating sutures complete the operation.

The pack is removed in twenty-four or forty-eight hours when danger of hæmorrhage is past and the case is handled by the usual methods following these operations.

A notable feature is the absence of all shock or depression, the pulse showing very little change after operation. Often there is not enough pain to justify a hypodermic. These cases are usually up in a chair in a few days and on their feet by the end of a week. The nourishment is usually restricted to liquids for the first day, after which they are permitted to eat what their appetite calls for. Many cases operated by this method show absolutely no after-disturbance of any kind and feel as if they had not been operated at all.

A HÆMOSTATIC SAFETY PIN FOR USE IN CRANIAL SURGERY

By LOUIS FRIEDMAN, M.D., New York

FOR the control of scalp hæmorrhage in cranial surgery a number of devices have been constructed; viz., some form of encircling tourniquet, either of rubber or steel band, as that of Landon's clamps, Kredel's hæmostatic suture, the deep back stitch sutures, or pins of the Makkas and Vorschutz type. The simple instrument which I present here for the control of scalp hæmorrhage can be used either in osteoplastic resection of the skull or for subtemporal decompression and is applicable to any region of the skull.

Figure 1 illustrates best the manner of its usage, the larger pins being applied. Due to the convexity and irregular planes of the surface of the skull, corners will be left uncontrolled by the larger pins. For these corners the smaller pins (A) can be used. The pin applied at the upper margin of the ear controls the superficial temporal artery, the main arterial supply in the temporoparietal region, so the main arterial trunks can be controlled either in the frontal or occipital regions.

In introducing the pin the bone should be closely hugged, so as to include the entire thickness of the scalp. At the point of exit of the pin the scalp should be depressed with scissors or an artery clamp, thus facilitating its exit and closure (Fig. 2). As the pin is closed like the ordinary safety pin and as the middle bar is controlled by two screws, it is sufficiently pressed against the scalp to control all bleeding. The pins should be introduced at least one-half to three-fourths inch from the proposed line of incision before the cut is made and should be left on until the scalp has been sutured and all visible vessels caught and tied. The pins are strong but light of construction, the larger four and one-half, the smaller two and one-half inches in length. They can be rapidly applied and control hæmorrhage sufficiently to give a bloodless field.

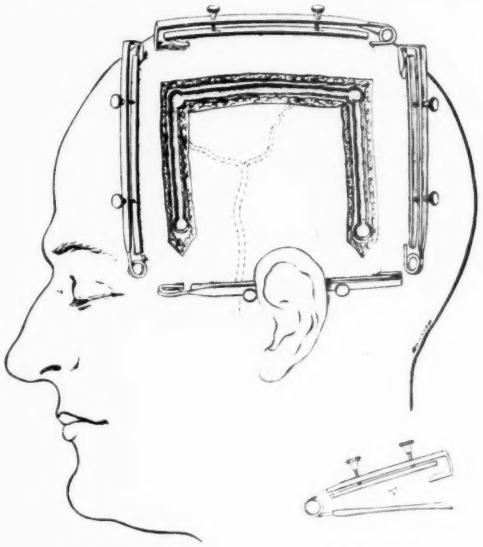

Fig. 1. Friedman hæmostatic safety pin applied.

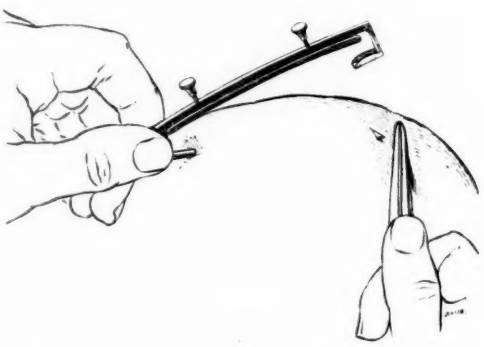

Fig. 2. Showing manner of controlling exit of pin.

PLAITING THE ROUND LIGAMENTS

By SIDNEY FREEMAN WILCOX, M.D., F.A.C.S., New York

THE procedure which I present is a modification of, or an addition to, the one devised by Martin of Chicago and is performed as follows:

First, any necessary vaginal and intra-uterine work should be done and it should be ascertained that the uterus is free from adhesions and that there is no pelvic inflammation. Then the operator feels along the upper edge of the pubic bone on one side until he locates the spine. A vertical incision is made directly upward from this point, about two inches in length.

When the tissues are cleared down to the aponeurosis of the external oblique muscle a bunch of fat is seen projecting from the external ring. This contains the distal end of the round ligament. Picking it up in the forceps and slitting the fibers of the aponeurosis as far up as the internal ring, the ligament may be separated from the surrounding fat and drawn out to its full length, stripping back its peritoneal envelope as this is done. The other ligament should be treated in the same manner.

It can be ascertained when both ligaments are free by making traction first on one ligament and then on the other. If the ligaments have been entirely cleared of adhesions they can be drawn forward and backward like a rope over a pulley. When not working on the ligaments, they should be kept warm and moist by wrapping them in gauze wet with warm saline solution.

The rings are closed with a continuous suture and for the slit in the fibrous aponeurosis I prefer a medium sized kangaroo-tendon thread. After the rings have been closed the distal end of one ligament is picked up in a pair of sharp-pointed forceps and passed through the fat above the pubis and made to emerge in the other wound. Then, releasing this ligament, the other one is caught and drawn back alongside the first.

My addition to the operation begins here and consists of passing the small end of each ligament several times through the thick part of the other one — as is shown in the illustration — and, to make the hold doubly sure, the end of each ligament may be threaded back through itself. The two ligaments are then stitched together with a few sutures of ten-day chromicized catgut and the wounds closed. These sutures should pass parallel with the long axis of the ligament so that the circulation shall not be cut off.

Fig. 1. The rings closed and the ligaments each passed through the other and back through itself.

The special advantages of this operation are:

1. The uterus is held in the forward position by its natural supports.

2. The ligaments enlarge normally during pregnancy and undergo normal involution after parturition. This has been demonstrated in several cases in my own practice.

3. The uterus is sustained in its normal relation to the abdominal wall by its ligaments which have been advanced in their attachments, equivalent to shortening.

4. The abdomen is not opened unless one desires to do so. I have gone in through the right wound and removed the appendix on several occasions. If it should seem necessary, one could follow the suggestion of Edebohls and pass a finger down into the pelvis and break up adhesions. Such a procedure would hardly be necessary if a careful previous examination had been made.

TUMOR OF THE CAROTID BODY

Report of a Case

By CASA COLLIER, M.D., Memphis, Tennessee

THE carotid body is a small structure, generally about the size of a grain of rice, situated in the bifurcation of the common carotid artery. The body was first described by Haller in 1743, and in 1862 Luschka wrote the first article dealing with its microscopic appearance. It is very intimately connected with the internal carotid and sometimes with the external or common carotid by the ligament of Mayer, through which it receives an abundant blood and nerve supply. It is in intimate association with and receives communication from the cervical sympathetic, vagus, superior laryngeal, and glossopharyngeal nerves. According to some anatomists, it is more retrocarotid than intercarotid; that is, it is more behind the internal carotid than it is in the bifurcation. If one not familiar with the insignificant appearance of this body were to undertake to expose it by dissection the probability is that he would say that it was not present. In fact, it is so difficult to detect that a great many observers have expressed the opinion that it is frequently absent, but, as is pointed out by Funke, this is erroneous. It is not frequently absent, but it frequently appears only as a slight thickening of the adventitia of the internal carotid, close to the bifurcation. This little body has brought upon itself quite a little investigation as to its embryology and very few investigators agree definitely as to its origin. Paltauf, von Heinleth, and Borst agree that it takes its origin from the connective tissue. Stilling and Kohn hold that it is of nervous origin and its parent is the embryonal ganglion cells of the intercarotid plexus.

Kaschtenko, who is a zoölogist and who has done extensive research in zoölogical fields, holds that it arises directly from the adventitia of the internal carotid artery, where, in the embryo, it can be seen as such, and there it consists only of the loose connective-tissue framework supporting frequent cell-nests; later the alveola form develops from this. The view most generally supported is that of Zuckerkandl, that these bodies arise from the sympathochromaffin system anlage which passes from the upper cervical sympathetic ganglion between the two carotids and that early in embryonic life this anlage buds off from the central nervous system.

Histologically, the body consists of a capsule from which are sent down into the gland connective-tissue septa, which divide and subdivide it into lobes and lobules, and these lobules are filled with epithelioid cells with large nuclei and distinct chromatin structure. These cells lie close together and there is a direct transition from them to the endothelial cells lining the blood-vessels which permeate the whole gland, each lobule receiving a branch. The cells are very similar to those found in the suprarenal and coccygeal glands, in the abdominal sympathetic, and in the pituitary.

It has been held that these chromaffin cells are responsible for the function of the gland, that they have an internal secretion, and that their action is in conjunction with the hypophysis cerebri and suprarenals. Extracts of the gland, however, have given widely varying results when injected, and so far nothing definite is reported. Mulon, using a watery extract, found that its action raises blood pressure and accelerates both the rate and force of the heart-beat, while Gomez obtained that there was a fall in blood pressure by using a glycerine extract.

Whatever the physiological action of the gland is, it is agreed by practically all investigators that its period of functional activity ceases at or soon after puberty, and that the gland undergoes fibrous degeneration. If this degeneration does not take place, the gland will enlarge. This enlargement is pathological, and although it is exceedingly slow and may run a benign course over a number of years before it becomes noticeable, it will in all probability eventually undergo a malignant evolution, and the probability is that it is then too late for the patient to be cured, as the operation is highly perilous. DaCosta, in his early discussion of the operation, says that he accepted as his surgical creed in regard to these tumors the view expressed by Keen, that every operation undertaken for tumor of the carotid gland may require resection of the vessels and nerves of the neck. Interference should be undertaken, therefore, only when serious functional trouble or rapid evolution of an apparently malignant character is present, thus justifying an attempt the consequence of which may be very grave. Now, however, he has greatly changed his viewpoint and advocates

immediate removal if the gland is either visible or palpable, as the chances for a cure are so much greater if the operation is undertaken while the tumor is small and before the malignancy occurs. With the exception of one epithelioma the tumors of this gland have been of the type of endotheliomata, known as perithelioma. The secondary malignancy is always sarcomatous. No case has been encountered before the eighteenth year, and it has favored slightly the female sex. With the exception of one bilateral case reported by DaCosta and one by Schmidt it has been unilateral, and seems to prefer the left side.

Among the clinical manifestations, the tumor alone is constant — rarely there is pain, pupillary irregularity, failure to react to light, hoarseness, dysphagia, headaches, and sometimes cardiac irregularity. Later there may be displacement of the larynx and paralysis of vocal cords.

The patient always presents herself on account of the tumor in the neck. This tumor lies high and presents anteriorly from under the sternocleidomastoid muscle. There is a history of very slow growth, extending frequently over a period of four to ten years or longer. The mass is firm and is movable laterally but not vertically. Pulsation can be felt. This, however, with the exception of Dr. Lilienthal's case. is not the expansile-pulsation of an aneurysm. There is usually some difficulty in differentiating these tumors from other tumors that may present themselves in the same neighborhood, such, for instance as tuberculous lymphadenitis, branchial cysts, aneurism, ectopic goiter, Hodgkin's disease, tumors in submaxillary or parotid salivary gland, fibroma, lipoma, lymphosarcoma, and hygroma.

In the case that I have to report, the patient, a woman of 50 years, presented herself for consultation concerning a tumor in the left side of her neck. This swelling was first noticed about five years ago, and has grown very slowly but very steadily ever since. It has given no pain other than could be attributed to the presence of a body of its size, such as a sense of fullness and the knowledge of its presence on swallowing. There was no pupillary irregularity or other manifestations of pressure on or involvement of any nerves. The pulsations in the left temporal artery, however, were very small when compared with those of the right. The tumor was firm and rather freely movable from side to side, but seemed firmly fixed when an effort was made to move it vertically. A probable diagnosis of tumor of the carotid body was made and the patient was X-rayed. From the anterior location of the shadow in the radiogram, it was considered that the tumor might be in the submaxillary gland, but operation was advised immediately. Under ether anæsthesia an incision was made over the anterior border of and parallel to the sternocleidomastoid muscle. By blunt dissection the tumor was exposed with considerable difficulty and in the face of profuse hæmorrhage. It had exactly the feel and appearance of a thyroid gland. The common carotid artery could be seen passing directly into the center of the lower pole and the external and internal emerging laterally near the top. The external carotid was ligated and cut, the gland was then rotated for inspection and the effort to dissect it free from the common and internal carotids was early abandoned for fear of hæmorrhage. The common carotid was then ligated below and the internal carotid above. They were cut and the tumor delivered. The wound was closed with a small gauze drain retained, which was removed on the morning of the third day.

The patient rallied beautifully from the anæsthetic — talked distinctly to the nurse and doctor, and complained of no pain. During the afternoon of the second day she developed a mild degree of œdema of the larynx and considerable hoarseness. Dr. A. C. Lewis was called in and prescribed atropin and an adrenalin spray. The œdema gradually disappeared but the hoarseness remained. The wound healed by first intention and the patient left the hospital on the sixteenth day. She suffered a paralysis of the left vocal cords, but her voice has improved considerably with the passage of time.

Pathological report. Tumor about the size and shape of a large walnut. Dark reddish-brown in color. Moderately dense fibrous capsule. Cut section has a delicate alveolar appearance. Microscopically, sections stained with hæmatoxylin and eosin shows an alveolar network of very cellular connective tissue, supporting a large number of capillary vessels, the walls of which are rather thick. The alveoli are filled with moderately large cells containing abundant protoplasm and having a medium-sized nucleus which stains well. The cells in the alveoli are apparently closely connected with the capillaries.

Diagnosis: Perithelioma.

Addenda. Since this patient was operated, the 4th of August, 1914, she has been under constant observation. Her voice improved gradually and at the present time she has her normal voice.

I wish here to express my indebtedness to Dr. J. C. Ayers, who assisted me in the operation and was associated with me in the after-treatment; also to Dr. A. C. Lewis, who was consulted in regard to the laryngeal œdema, and to Dr. Jesse J. Cullings, whose pathological report is given above.

I lay no claim to the originality of this article. It is largely a résumé of the literature the bibliography of which is appended.

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DESTRUCTION OF THE SPINAL CORD BY MOLECULAR VIBRATION

With Report of Case

By A. P. BUTT, M.D., F.A.C.S., Davis, West Virginia

WHEN the vast amount of material now accumulating is finally worked up, the experience of a single surgeon will, I surmise, be of little benefit. Until then, the case I have recently seen seems worth reporting.

F. H., male, age about 45, medium build; referred by Drs. Huff and Huff, of Parsons.

While at a shooting match, on December 24, a rifle, containing a steel-jacketed, soft-nose bullet of about .30–30 caliber was accidentally discharged. Patient was about 6 to 8 feet from muzzle of gun. He immediately fell to the ground paralyzed.

He was rushed to the Allegheny Heights Hospital. I found him complaining of numbness in the first two fingers of the left hand. Examination showed that the bullet had entered the back about 2½ inches to the right of the midline, course downward; it had been deflected by the vertebra, passed upward through the thorax, emerged through the left axilla, entered the inner side of the left arm, and had lodged in the biceps muscle. The patient spat some blood. There was complete motor and sensory paralysis from a little below the umbilicus. Reflexes all abolished except cremasteric. On the second day after the injury a partial erection of the penis was noticed.

Bullet removed under local anæsthesia. Inspection showed no deformity of the spine, palpation showed the tenth dorsal spinous process to be fractured.

About 54 hours after the injury it was determined to operate. The family were informed that in my judgment it would do no good, that it was simply a forlorn hope. Operation was started under novocaine; finished with a very little chloroform. The spinous process was found to be fractured at its junction with the laminæ. A large wound in the pleura caused considerable respiratory distress. It was plugged with wet gauze. Exposure of

the dura showed it to be uninjured, no pressure from spicules of bone, no blood. The dura was opened; findings negative.

There was no improvement after operation, and the patient died on the seventh day.

No autopsy was allowed other than the examination of the cord. Several inches of this covered with the dura were removed. Absolutely no injury to dura or cord could be seen until after the pia mater was opened.

The condition was so typical of that described by O'Reilly in Keen's Surgery,[1] that I shall give it in full.

[1] Vol. iv, 1006.

He says: "Destruction of the cord may occur as the result of transmission of energy from a missile of high velocity passing near the cord. This shattering of the cord by molecular vibration has been noted by all observers as the result of the use of the modern high-velocity projectile. It has occurred in cases where the bullet barely grazed the membranes of the cord.

The cord is reduced for some extent to a custard-like material and is as completely and permanently destroyed as though it had been severed by a missile."

In this case it could not be seen that the membranes had been even grazed.

A SIMPLE METHOD OF ESTABLISHING VAGINAL DRAINAGE

By JAMES C. WOOD, M.D., F.A.C.S., Cleveland, Ohio

ALL abdominal surgeons must have experienced at times a certain degree of difficulty in establishing vaginal drainage, when it is deemed necessary, after dealing from above with septic conditions within the pelvis or the abdomen. It is not always an easy matter, even under the most favorable conditions, to get into the vagina from above. To make a vaginal puncture it is ordinarily necessary to disarrange the aseptic sheets and to provide an extra sterile assistant to conduct, by the sense of touch, the perforating forceps into the posterior vaginal fornix; in case the extra assistant is not available, the surgeon is compelled to change his gloves and gown after he himself has carried the forceps into the vagina. To overcome this the writer has for some time been using a technique which has greatly simplified the procedure. Indeed, the technique is so simple that it is more than probable that many other surgeons have used the same method. I have, however, never seen it described in print.

I had my instrument dealer convert a large-sized, full curved Pean forceps into a trocar pointed instrument, with a hole drilled transversely through its tip large enough to care for a medium-sized catgut ligature. When it is probable that vaginal drainage will be required, the vagina is sterilized and all necessary work from below completed. A short, full curved needle with a No. 0 plain catgut is carried through the mucosa of the posterior fornix at a point where the cul-de-sac of Douglas can be most easily and safely penetrated. This ligature is now carried through the opening in the tip of the forceps and firmly tied, the point of the instrument being thus held in close proximity to the mucous membrane in the posterior fornix by a ligature easily broken.

The forceps should be long enough to project some six or eight inches from the vaginal ostium. The catgut is only strong enough to hold the instrument in position while the work from above is being completed. After its completion, and under the eye and touch of the operator, a nurse, who need not necessarily be sterile, is instructed to pass her hand under the protective sheets from below, force the blades of the instrument into the cul-de-sac of Douglas, and expand them so as to make the vaginal opening large enough to draw into the vagina a strip of gauze or a drainage tube, as the case may require. In case drainage from below is not deemed advisable, the forceps can be easily withdrawn without the least danger of disturbing the uterus, providing a No. 0 or a No. 00 catgut is used.

A PRACTICAL OBSTETRICAL BED

By EUGENE CARY, M.D., Chicago

THERE has been a long-felt need of an obstetrical bed that would be practical for the obstetrician and at the same time comfortable to the patient. We have all had the experience many times of delivering a patient in a sagging bed. Also, we have often heard patients in hospitals complain bitterly of the hard tables upon which they were compelled to lie.

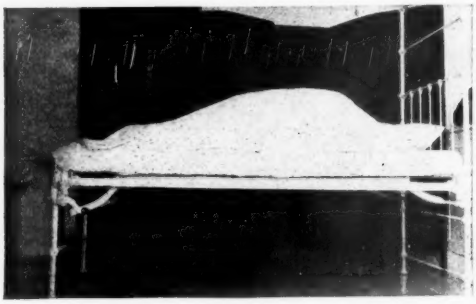

Fig. 1. Bed before lowering under-frame.

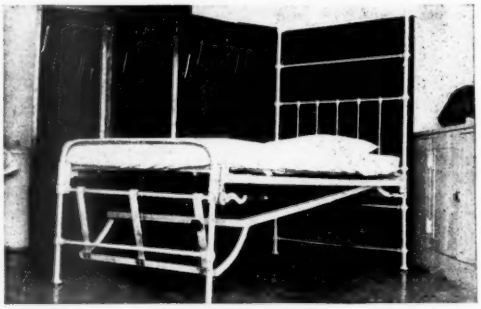

Fig. 2. Under-frame lowered, showing raising and lowering device.

It would seem that the ideal bed for delivery would be one which is comfortable and at the same time easily convertible into an operating table. Such a bed, designed by Dr. Frank Cary, has been in use for several years in the obstetrical department of St. Luke's Hospital. I append photographs of the bed.

It is as comfortable as any bed and can be made flat and firm, securing a maximum of comfort for the patient and a minimum of disadvantage to the operator.

The bed is a regular hospital bed, having, in addition, a steel under-frame covered with sheet metal. This frame is hung in such a manner that it fits just inside the regular frame of the bed, and when in place, lies snugly against the under side of the bed-springs. To facilitate raising and lowering this under-frame, its upper end is hinged to the legs at the head of the bed; its lower end being manipulated by three straps which wind up on a roller by means of a crank. A ratchet keeps the latter from slipping. The original design contemplated a mechanical device for raising and lowering the steel table, but was abandoned in favor of the cheaper method.

A patient lying on this bed is perfectly comfortable and would not realize that the bed is different from the regular hospital bed, since the under-table is not yet raised. As the time for delivery approaches, the steel table is elevated converting the comfortable bed into a practical operating table.

We have used this bed in hospital practice for the past five years and have found it most satisfactory.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD JANUARY 15, 1915, WITH THE PRESIDENT, DR. ROBERT T. GILLMORE, IN THE CHAIR

A CASE OF SPASTIC PARAPLEGIA AND BIRTH, THE PARAPLEGIA SUBSEQUENTLY OPERATED AND CURED

DR. N. SPROAT HEANEY, DR. DEAN LEWIS, and DR. PETER BASSOE reported this case jointly.

DR. HEANEY in reporting the case said:

This patient was admitted to the Presbyterian hospital on January 22, 1912. She was 21 years of age, and was married in June, 1911. She had but one menstrual period after marriage. She had always been well and had gained several pounds in weight from the time of marriage until she was admitted to the hospital.

She gave the following history: Six weeks ago she began to notice a feeling of numbness in the toes of the right foot. The numbness appeared on the opposite side and became more extensive. When she was admitted to the hospital she was completely paralyzed in both lower extremities. She had a well-developed spastic paraplegia. The feet were drawn up; the knees were flexed, and she could not stretch out the legs. She had some muscle-sense, but pain, sensation, and motion were obliterated. She was about seven months pregnant.

The X-ray plates which Dr. Lewis will present to you show a softening of the body of the fifth dorsal vertebra.

Several questions arose as to what to do: whether to let her go on with the pregnancy and, if so, whether birth would occur at term, or whether she would probably go over term.

From our knowledge of reported cases and from animal experimentation it is known that connection with the brain is not necessary for the maintenance of pregnancy or for the timely onset of labor. The first stage is normal. Because of paralysis of the abdominal muscles, expulsive efforts are in abeyance, so that the second stage is prolonged. The calcium balance is usually defective in pregnancy so that carious processes in teeth or bones are unusually rapid in their progress, which fact probably explains why the course of the paralysis was so rapid in her case.

She was able to feel fœtal movements during pregnancy and was able to empty the bladder and bowel although there was some difficulty in starting them. Birth was due March 30. On the first of April she went into labor, and the labor was practically painless. The patient had a bearing-down sensation and a sense of pressure in the abdomen. After three and a half hours of labor the membranes ruptured, effacement being complete, and the cervix being about the size of a half-dollar. Twelve hours later the head rested on the perineum. The patient then made no progress and was tired out, so she was given a hypodermic of one-quarter grain of morphin, which gave her 4 hours' rest. Pains again returned and the patient constantly had a desire to defecate. No progress was made and the patient could not bear down. After 24 hours of labor the fœtal heart tones went up to 170, and meconium began to pass. The patient was taken to the clinic and Dr. Webster applied low forceps. No anæsthetic was required. She felt the forceps being applied but had no pain although she complained of a disagreeable stretching sensation during the easy extraction of the child, which was a boy weighing six pounds and thirteen ounces. The puerperium was normal. She nursed the baby and it gained rapidly in weight. The third week after delivery Dr. Lewis took the case in hand and did a laminectomy, with the final result that the patient is in full health, is able to work, and has no paralysis.

This case is interesting because of the complete restoration of function after laminectomy and because of the physiological questions brought up concerning birth under conditions of separation of the cerebrum from the lower portions of the cord.

DR. DEAN D. LEWIS: The X-ray picture reveals a peculiar lesion. It is not exactly that of tuberculosis, for the bodies of the vertebræ are not destroyed. The lesion at the level of the fifth and sixth dorsal vertebræ appears to be a definite periostitis with new-bone formation, but not associated with much destruction. There is no gibbus. On account of the definite X-ray findings and the paraplegia a decompressive laminectomy was performed, three laminæ being removed. When the cord was exposed a rather extensive definite pachymeningitis was found. Believing that the lesion was probably tuberculous, the dura was not opened for fear that a tuberculous leptomeningitis might develop. The laminæ were merely removed and the cord freed from pressure. The return of sensation was rapid, a definite sensory return being noted within forty-eight hours. In ten days there was a definite return

of motion in the toes. The improvement has been progressive, until at the present time the patient is practically normal. I believe that a syphilitic lesion can be ruled out in this case. The Wassermann was negative and no antisyphilitic treatment was instituted.

THREE CASES OF PAPILLARY CYSTADENOMA

DR. WILLIAM M. THOMPSON: I wish to report briefly three cases of papillary cystadenoma. It is rather unique for one to come across three such cases so close together, each one representing a variation in the form of a papillary cystadenoma.

The first is a small growth evidently a protrusion from the ovary and growing simply as a warty tumor. The appearance of this is similar to condylomata, but it had no metastasis in the pelvis. I expected to find metastasis somewhere, but found none in this case, even with the papilloma outside of the ovary for some time.

The other one is of exactly the opposite type. The interior of the cyst is lined with the papillæ, and it was filled with pseudomucin or gelatinous cysts, as the English call them, and was not ruptured. There was no metastasis in the abdomen in this case.

I will pass these cysts around so that you can compare them. These were two simple cases, one in which all of the papillæ seemed outside of the ovary, and yet there was no metastasis, and no evidence of blocking of the endothelium and ascites in the abdomen that usually occurs in these cases.

The third case was operated a few weeks ago, and the cyst removed was so large that I brought only a part of it. I am sorry I have not the whole cyst because it is the most unusual tumor of the kind I have ever seen. You see it is a typical gelatinous cyst, which ruptured through this opening evidently, not by a protrusion of papillæ but from thinning of the membrane. The membranes in these cysts are very thin and break readily. The loculi break into each other. The cyst ruptured and turned wrong side out, and enough of the small cysts remained so that there was a large tumor, and the abdomen was full of this gelatinous fluid. This woman was forty-five years of age and unmarried. She had curious heart symptoms which resembled very much the heart symptoms of a myoma. When I first examined her, I also examined the heart and thought of a myoma. Doubtless you have all read papers and discussions in the literature recently on heart trouble in myomatous disease of the uterus. I naturally thought of myoma, but when I looked at the abdomen it was broad. It was not hard, nor as resistant as in a case of myoma. The flanks were dull. The dullness extended up around the liver. This dullness did not change as the patient sat up, as it would in ascites.

Having seen two other cases similar to this, I concluded it was some kind of pseudomucinous cyst, but I had no idea it had ruptured to such an extent. When the cyst was removed it was not possible to take away all of this gelatinous substance. The abdomen was full of it. As you all know, the substance does not confine itself to the pelvis as fluid ordinarily does. It is not governed by the force of gravity, but it gets up under the liver, about the spleen, in the region of the stomach, and underneath the omentum. I scooped out handfuls of it. The question arose as to what to do: whether, as some surgeons suggest, to dissolve this with salt solution, which is the solvent recommended, or let it alone. I was much afraid of infection, and so I closed the abdomen without endeavoring to wash it out. I scooped out as much as I could before closing the abdomen. The patient has since had thrombophlebitis on both sides.

DR. A. BELCHAM KEYES: This is an extremely interesting variety of the ovarian cystomata. The first type of cystadenoma that we generally think of is the one which may grow to very large size, the cystadenoma pseudomucinosum usually of the "evertens" type, less often, as in two of these exhibited by Dr. Thompson, of the papillary or "invertens" type. These tumors, if the loculi rupture, never cause any growth upon the peritoneal surface and comparatively rarely undergo malignant degeneration. The cystadenoma (invertens) serosum with serous contents—the ovarian papillomata of the old authors—now termed "serosum" is not represented in this exhibit. They almost always cause papillary growths upon the peritoneal surface, and are very prone to carcinomatous degeneration; complete recovery in these cases after removal is much less frequent. The cystadenoma serosum is said usually to grow from the hilus cells of the ovary, which are sometimes ciliated.

Pozzi of Paris read a paper at a joint meeting of the Chicago Medical and Chicago Gynecological Society on this subject and received a great deal of adverse criticism for saying that the prognosis was better if much care was exercised in removing all peritoneal growths also. In a talk with Nagel he even advised not to observe the rule to remove the apparently healthy ovary of the other side if the woman is in the reproductive period and desirous of bearing children. I have recently heard from two patients from whom I removed this type of tumor with removal of extensive peritoneal growths who have been perfectly well since the operation two years ago. The others have all died.

As for the very rare and interesting gelatinous tumor exhibited here tonight by Dr. Thompson —cystadenoma pseudomyxomatosum, composed of a Wharton jelly-like material which grows readily upon the peritoneal surface —if the loculi rupture Dr. Thompson will probably have to reopen the abdomen of this patient in 3 or 4 years to remove the reaccumulation on the peritoneal surface. Dr. Henrotin and I had one case in which we had to reopen the patient. Other than the reaccumulation of the gelatinous material, they do not appear to be malignant.

I am sorry I did not know that these tumors were

going to be shown, or I would have brought some sections of all kinds with me.

I have never before seen but one case of the pseudomyxomatous kind of tumor.

Dr. Thompson deserves the congratulation of the Society.

DR. DEAN D. LEWIS: Pseudomyxomatous peritonitis is always of considerable interest. It or closely allied conditions may occasionally develop from lesions which do not resemble each other closely. A little over a year ago I operated upon a woman for a supposed ovarian cyst. After I had delivered and had removed the tumor, after having clamped the pedicle, I found that I had removed part of the cæcum. The lesion was an enormous mucocele of the appendix. I later heard of a case in which a surgeon had operated upon an obscure lesion of the abdomen and had found a condition resembling a pseudomyxomatous peritonitis. In looking over the abdomen he found a mucocele of the appendix which had ruptured. Thinking that he was dealing with a colloid carcinoma of the peritoneum, he closed the abdomen, expecting the patient to die. Improvement was immediately noted. The condition within the abdomen improved and the patient made an uninterrupted recovery. This peculiar condition within the abdomen evidently followed rupture of the mucocele.

DR. THOMPSON: I want to thank Dr. Keyes for his remarks on the pathology of these cysts. The pathology, as given in our textbooks, is very vague. It is very essential to make a distinction between the malignant and non-malignant types of these tumors.

Last year I operated on a woman three times who had a papillary cystadenoma malignum, as some authors call it. We worked that case out carefully. Dr. Dick did the pathological work. There were metastases found in the second and third operations. In that tumor there was, in addition to a carcinomatous area, a fully developed dermoid. Dermoid is frequently found in these cases.

THREE CASES OF ABNORMAL DEVELOPMENT OF THE FEMALE GENITALIA

DR. MARK T. GOLDSTINE: Last spring I reported to the Society three cases under this heading. Tonight I want to add three more, making a series of six cases of abnormal development of the genitalia inside of sixteen months.

CASE 1. Mrs. M. D., Summit, Illinois; aged 23; married two years. Menstruation began at thirteen, twenty-eight-day type, lasting three to four days; copious flow; last menstruation first week of March, 1914. Patient consulted a physician in May, six weeks after missing her period. This doctor dilated the uterus. Seven weeks later the patient went to another doctor who did a curettage to get rid of supposed retained products of conception. He, however, did not find any. Patient entered the hospital July 9, 1914. For the last month she noticed a mass forming on the left side which is growing larger. Considerable pain in limbs and sacral region for the last six weeks, which is worse on standing. There was a slight flowing for a few days after curettage.

Examination showed the external genitals normal; vagina divided in half by a strong septum; left vagina a blind pouch; right vagina contained a large cervix. Bimanual examination disclosed a large mass about the size of a four months' pregnancy. On the left side there was a small mass which resembled the uterus on the right. Both were distinctly separated.

Laparotomy showed an apparently normal uterus with its tube and ovary on the right; the mass on the left had its origin from the upper part of the cervix of the right uterus and resembled a pregnant fundus in every detail. The left tube and ovary were attached to this mass. This accessory fundus was removed and contained the products of a four to four and one-half months' conception. Subsequent examination showed the cervical canal of the uterus on the right side to be intact.

CASE 2. The second case was one of salpingitis. Nothing out of the ordinary in the history. The girl was twenty years of age. Examination revealed a double mass in the pelvic region for which a laparotomy was done. Patient has a double pyosalpinx. The uterus on the left was normal in size and shape; on the right separated from the left uterus, about one and one-half inches, was another immaturely developed uterus minus the cervix and connected with the left uterus by a tube which opened into both uteri. Attached to the right uterus was the ovary and tube of that side. The appendix was removed, and was about two and one-half inches long, and indurated for about an inch from the tip downward. Sections showed an endothelioma of the appendix.

CAS 3. Miss C., aged 22. Never menstruated. always enjoyed good health. Examination showed the external genitals apparently normal. Urethra opening in normal position. Anus in normal position. Absence of vagina or vaginal opening. Laparotomy showed an absence of the uterus, left tube and ovary and left broad ligament; about one-half of the right tube, and normal right ovary attached to a small fold of broad ligament to the extreme right of the pelvis. Bladder apparently normal.

CASE 4. The fourth case is an unusual one of extra-uterine pregnancy. The specimen shows how large a tube can develop before primary rupture. It is rather an unusual specimen.

DR. HENRY F. LEWIS: There is very little that can be added to the teratological aspects of these cases because the author has said about all that there is to say.

In those cases where we get a small infantile uterus it is interesting to see the effect of sexual stimulus upon it. I have in mind a case that came under my observation several years ago. The patient, a woman about thirty, had never menstruated. She came to be examined for that reason.

I found a very small uterus which one could barely feel. She married and began to menstruate in the course of a few months. Finally, she began to have vesical and pelvic symptoms which led her to think she might be pregnant. Instead of a pregnancy, I found she had a fibroid tumor. The uterus was as large as a fist. She has not yet consented to operation.

DR. HEANEY: What are we to do in a case in which we discover pregnancy in a well-developed horn of a bicornate uterus? I ask this because I really was present at an operation where the question of procedure arose. I believe that we had best close the abdomen if the horns are well developed. That women under such circumstances bear children with no difficulty and without the condition being even suspected is undoubtedly a fact. Once when assisting Dr. Webster, he operated upon a woman for double pyosalpinx who had given birth to three or four children without difficulty. She had a bicornate uterus and each horn had apparently gone through pregnancies. Of course, occasionally the hypertrophied non-pregnant horn gets in the way and obstructs the birth canal at labor, but is this frequent enough to justify operating upon a pregnant bicornate uterus if the horns are well developed? If either horn is removed the scar weakens the lower uterine segment of the remaining horn so that the chance of rupture at the time of labor becomes quite a probable thing.

DR. W. A. NEWMAN DORLAND: The second case reported by Dr. Goldstine, namely, absence of the uterus with the presence of one ovary, brings up an interesting thought. In all probability those women who have these rudimentary ovaries or fragments of ovaries, with absence of the uterus and vagina, retain their feminine traits because of that fact.

I recall an Italian girl, quite a well-developed woman, married, twenty-one years of age, who was brought into my clinic at the Pennsylvania Hospital by her husband to find out why he could not have proper relations with his wife. That woman was well developed in every respect, save that she had no uterus. The vagina was infantile, just large enough to admit the tip of my index finger. Subsequently she underwent a laparotomy, and then it was found that she had on both sides rudimentary ovaries, but no uterus. There were simply fragments of ovarian tissue. She had the feminine traits. Subsequently, I saw at the Polyclinic Hospital another case of absence of organs, with a vagina so small as barely to admit my thumb. This woman had a remarkable growth of hair upon the lips, and while she had a feminine voice when she spoke, when she laughed it became decidedly masculine. An operation was done on her afterwards for some trouble in her appendix or intestine. Dr. Slocum, who operated, found no uterus and no ovarian tissue.

DR. THOMPSON: I would like to ask if women with bicornate uterus are more prone to miscarriage. I know of one case where a woman miscarried twice, and the last time I tried to get control of her I was going to take her to the hospital, but she got away from me.

DR. THEODORE J. DOEDERLEIN: Perhaps it would be opportune to recall a case I once reported to the Society, of pregnancy in an adenomyoma which occurred in the practice of von Recklinghausen. It was an unique case, and we called it then a new type of ectopic pregnancy. No other case had been observed before, and since Dr. Thompson referred to the possibility of miscarriage in such cases, I will say that in this case there was evidently a breaking down of the adenomyoma. The center of the adenomyoma had broken into the uterus and through the fistulous tract the fertilized ovum had developed in the adenomyoma with a subsequent miscarriage at a period of about four months. Dr. Herzog and I investigated that case to see whether we were right. Some called it interstitial pregnancy or pregnancy in Gärtner's duct. Our investigation and subsequent examination disclosed beyond a doubt that it was a pregnancy in an adenomyoma. This class of cases of ectopic pregnancy—to which all these pregnancies of the bicornate, variety belong—certainly comprise most unique cases.

DR. GOLDSTINE: We debated whether or not to let pregnancy go on, knowing it would be inevitably cæsarean section, as I did not see how she could be delivered normally with the cervix pointing in the direction described. Subsequent examination showed the vaginal canal intact. The fundus lay against the pelvic wall.

DR. HENRY F. LEWIS: What was the condition of the tube on the pregnant side?

DR. GOLDSTINE: The tube and ovary were normal. It was a case such as I reported last year where I had a double uterus, double vagina, and cervix, and that woman had normal delivery from her uterus and is menstruating normally today.

EXPERIMENTS ON THE PRODUCTION OF THERAPEUTIC ABORTION AND LABOR AT TERM

DR. ARTHUR HALE CURTIS[1] reported rather briefly some experiments which he has been doing on the production of therapeutic abortion and labor at term through the use of placental extract.

ELEPHANTIASIS OF BOTH LOWER EXTREMETIES

DR. ROBERT T. GILLMORE reported a case of elephantiasis admitted to Wesley Hospital January 12, 1914.

Mrs. X., age 27, native of West Virginia. The patient was born in a healthful farming country and remained there up to three and one-half years ago. Family history negative except father who was said to be "scrofulous." Patient was nursed at mother's breast for two or three months and then brought up on cow's milk.

History. Patient says that she has had "lumps" under the skin, on each side of the vulva since infancy. When she first remembers them they

[1] Surg., Gynec. & Obst., 1915, xx, 292.

were about the size of hazelnuts, round, and as hard as her cervical glands are at present. The glands were movable under the skin and during her childhood they caused no discomfort unless they were rubbed which would cause them to become tender. There was no soreness or swelling of the vulva and no vaginal discharge. These swellings gradually increased in size, the one on the right side to the size of a hen's egg, while that on the left scarcely increased. The maximum size was reached about the time she began to menstruate, at 17 years of age.

Menstruation. She began to menstruate at 17 years of age, and this first menstruation and those for about three years afterward were accompanied by chills and fever. These symptoms gradually decreased in intensity until they ceased altogether. She would be in excellent health until the onset of her period, when she would have a severe chill, which usually occurred at night and lasted about two hours and she would be compelled to remain in bed. This chill would be followed by a high temperature and profuse perspiration. The following day she would be so weak that she was obliged to keep her bed. In about 24 hours another chill with accompanying fever and perspiration would repeat itself. This would be repeated every 24 hours until the menstrual flow was established. The community in which she lived was not marshy and to her knowledge there were no cases of ague.

Symptoms after menstruation. After having a chill, she would suffer with pain across the upper part of the lumbar region, and with frequent urination. All these symptoms ceased with the cessation of the chills and fever three years afterward.

Physical condition after menstruation. With the establishment of her menstruation, the patient observed a gradual swelling of the right lower extremity. The year following, the left lower extremity began to increase in size. There was never any swelling in any other part of the body. This enlargement neither ascended nor descended; the swelling seemed to be general from the hips to the ankle. It was at first soft, pitting on pressure. gradually becoming more boggy. During the chills she frequently observed that the skin became red, but this condition soon disappeared, leaving the legs and thighs aching and sore, with the skin painful to touch. Following the fever the skin would peel and the surface become raw. It is possible that this local irritation was due to a chloroform liniment which she used freely at such times. During the above-mentioned paroxysms the right leg would become so painful that it would become involuntarily drawn upon her thigh. There were no pains in the joint.

Present history. Of late she has developed a throbbing pain in the knee of the nature of a toothache, which gradually wears away. Her joints were never swollen. She was never troubled with neuralgia in her leg. Her foot has never been painful or swollen. With the increase of the size of the lower extremity the surface has become harder; this hardness markedly increased for five years, since which time it has been stationary. At the present time this limb causes her no pain, it becomes tired when it is used, it does not become cold and it does not become softened to feel when elevated. There are no ulcers. She can stand up all day with no discomfort except a tired feeling, and the throbbing pain in the knee.

Fig. 1. Dr. Gillmore's case of elephantiasis of both lower extremities.

The left lower extremity began to enlarge about one year after the right. After two or three periods it was about the same size as the right and has seemingly remained stationary.

Examination of heart, negative; of lungs, negative; Wassermann, positive.

Blood examination: Repeated attempts were made to find the filaria sanguinis hominis, both at night while the patient was resting, and during the day, with negative results. Red blood count, 4,216,000; white blood count, 6,400; differential lymphocytes, 20 per cent; polymorphonuclear, 80 per cent; hæmoglobin, 85 per cent; urinalysis, negative. During her stay in the hospital the temperature frequently went as high as 99.8° and twice it reached 100°. The pulse during the afebrile period was 72.

During the high temperature the pulse rate was from about 95 to 100.

DR. GILLMORE (after exhibiting the patient and reading the history of the case): This case seems to be one of the non-filarial forms of elephantiasis. There are a great many causes given for this condition outside of filaria when it does not occur in tropical countries. The disease is more or less epidemic in those countries, but in this country we do not find it so frequently. Syphilis has been mentioned as a cause by some authors, also traumatism, and especially streptococcic infection, which is found in some cases.

In regard to the treatment, at present we are treating this woman for syphilis, and as long as she is able to go about and attend to her household duties as she is, there does not seem to be any definite indication for operation. She is suffering from no great disability. She does her work cheerfully, and the disease does not seem to depress her.

We can find no areas of anæsthesia. There is no hypersensitiveness due to the nerves not being involved in the pathological process. There is no breaking of the skin, and there is no way of getting any secretion in which one might find filaria without operating. We might remove a portion of the tissue, but owing to the lymphatics being more or less involved, the reparative process would be interfered with, and I do not think we are justified in removing a piece for diagnosis at present.

DR. DEAN D. LEWIS: Is it not possible that these attacks may be due to a recurring lymphangitis, and not to the application of chloroform liniment?

DR. GILLMORE: I do not know, but it might be the cause of the irritation of the skin.

DR. LEWIS: We see these cases associated with inguinal lymphadenitis and after operations for removal of diseased glands. I have a patient in the hospital with a marked lymphœdema of the right lower extremity. He has had recurrent attacks of lymphangitis, accompanied by a general reaction and marked redness of the skin. It is rather common to see elephantiasis following removal of inguinal lymph-nodes for suppurating bubaes.

Heretofore we have regarded these cases as practically hopeless, when as a matter of fact we might have done something for them. I do not think that Handley's operation promises much. Kondoleon devised an operation which has given some relief and should be tried oftener. The deep fascia of the thigh and leg offers a distinct barrier between the superficial and deep lymphatics and the operation devised by Kondoleon consists of removing a piece of the deep fascia, so that the subcutaneous lymphatics may come in contact with those of the muscles, with the idea of forming an anastomosis. In some cases strips have been made of the fascia and these have been run from the subcutaneous tissues into the muscles in an attempt to form new lymphatic channels.

DR. FRANK A. STAHL: I would like to ask Dr. Lewis the philosophy of the Kondoleon operation.

DR. LEWIS: The operation is done for the purpose of establishing circulation between the deep and superficial lymphatics.

DR. STAHL: In a line with my question to Dr. Lewis there seems to me here in the clinical picture of the patient a suggestion as to a favorable line of treatment. We notice, comparatively speaking, a small-sized slipper projecting from the skirt line with no evidence of an unusual enlargement. Removing slipper and stocking we see a characteristic well-marked elephantiasis of the whole limb from the dorsum of the foot upwards. About the foot is a well-defined compression ring outlining the rim of the slipper. At this ring, the elephantiasis seems limited, increasing from here upward and ceasing downward. This slipper ring apparently limits the growth by compression, which is similar in philosophy to the compression check resulting in the Chinese foot. Herein may be a suggestion in therapeusis from Nature. As from the slipper, a long-continued, permanent, inhibitory pressure might cause compression atrophy, as by means of an elastic stocking, at times supplemented by a general or local bandage, as suggested by the local condition of the patient. Pressure is suggested in all works; here we have a well-marked hint from her slipper.

DR. GILLMORE (closing): This patient, while in the hospital, had a few exacerbations of fever from no apparent cause. Her temperature went up to 100° and pulse to 90, on three different occasions. It frequently went up to 99°, and it was probably due to lymphangitis,

Treatment. The question in regard to pressure has been tried by several observers. Authorities do not speak of it very favorably, although it will do no harm.

In regard to the operation of Kondoleon, I think eventually it should be tried on her, operating on the right leg first for the purpose of establishing a circulation between the superficial and deep lymphatics.

JOINT MEETING OF THE CHICAGO SURGICAL AND THE CHICAGO PATHOLOGICAL SOCIETIES

HELD JANUARY 8, 1915, WITH THE PRESIDENT OF THE CHICAGO SURGICAL SOCIETY, DR. DANIEL N. EISENDRATH, IN THE CHAIR

SARCOMA OF THE SCIATIC NERVE

DR. COLEMAN G. BUFORD reported a case of "Sarcoma of the Sciatic Nerve," and exhibited the patient. This report will appear later.

DR. THOMAS A. DAVIS: I wish to report on this same case at an earlier stage. Dr. Buford's statements of the clinical history of the case are in accordance with the history I obtained.

I made the diagnosis of fibroneuroma with the knowledge that the fibroneuromata rarely grew larger than a hickory-nut, although this tumor was as large as an agg. In consequence of its large size, together with the history of the case, I thought it might be sarcoma, and I removed the tumor.

I wish to call attention to this growth which is apparently different physically from the one which Dr. Buford shows. I have a smooth globular-shaped tumor which shelled out of its capsule in the split nerve like a pea out of its pod. When I incised it I found a softened area in the center which led me to change to the positive diagnosis of fibromyxoma, essentially a sarcoma. I advised a more radical operation when the diagnosis was confirmed by Drs. Mefford and Long in their laboratory report. The tissues in Dr. Buford's specimen, both macroscopic and microscopic, are those of a sarcoma; while the tissue in my specimen shows the characteristics of a fibroma—smooth, hard, round, and under the microscope you will see the wavy bundles of fibrous tissue throughout, excepting at the border of softening or degeneration where the polymorphous cells predominate. As I have said, I advised the patient to undergo a more radical operation but he disappeared from the clinic.

I saw the patient a few weeks later. He had been to the Cook County Hospital where an amputation of the hip-joint was advised. I believed that hip amputation offered the only promise because the soft tissues far from the nerve seemed invaded by the tumor and thus concurred in the advice.

DR. ARTHUR DEAN BEVAN: I have knowledge of two similar cases, one in my own practice, and one in that of Dr. Mackenzie of Portland, Oregon. The resulting condition as seen in this patient is interesting and somewhat surprising, and yet when you analyze the facts it is what you might expect with a putting out of function of the sciatic nerve, the rest of the limb being supplied by the lumbar plexus, and the motion and sensation that the patient has coming from the lumbar plexus. He is in exactly the condition my patient was immediately after operation, at which a large tumor was removed from the sciatic nerve, and is walking surprisingly well.

Dr. Buford referred to the sensation on the inner side of the leg. Of course, that is from the lumbar plexus, from the internal saphenous nerve. The function is just what you have from the lumbar plexus itself.

I have this suggestion to make that instead of a hip amputation in a case of this kind, one might be very well satisfied with a very radical extirpation of the tumor without attempting to repair the sciatic nerve, depending upon the motor function from the lumbar plexus, with an arthrodesis of the ankle-joint. That would give the patient a very useful limb. The quadriceps extensor receives its nerve supply from the lumbar plexus and controls the knee fairly well as far as extension is concerned. The hamstrings receive their nerve supply from the sciatic above the line of division, and with an arthrodesis of the ankle-joint the patient would have a very useful limb. At the same time one could do an extensive radical operation.

DR. BUFORD: I would like to ask Dr. Bevan whether he has made any effort at nerve-grafting or filling in the gap?

DR. BEVAN: Yes.

DR. BUFORD: Did you have any luck?

DR. BEVAN: No. There was a good case reported by Mackenzie four years ago in the *Transactions of the American Surgical Association*, in which he resorted to extensive grafting.

EXPERIMENTAL OBSERVATIONS ON THROMBOSIS AND EMBOLISM

Dr. ANGUS MCLEAN, Detroit, Michigan, read a paper, by invitation, entitled "Experimental Observations on Thrombosis and Embolism" (See p. 457).

BACTERIOLOGY OF VASCULAR INFECTIONS

Dr. E. C. Rosenow read a paper entitled "Bacteriology of Vascular Infections." (See p. 403.)

SURGICAL IMPORTANCE OF INFECTIONS WITHIN THE VASCULAR SYSTEM

Dr. John B. Murphy followed with a paper entitled "Surgical Importance of Infections within the Vascular System."

These three papers were discussed jointly.

DISCUSSION

Dr. Arthur Dean Bevan: I was much interested in Dr. McLean's experiments, especially the definite fact that an aseptic thread would not produce coagulation of the blood in the vein; that with the added factor of pus organisms, these blood-clots were constantly produced. I think that has an important practical bearing. It is a very simple practical bit of evidence which he has presented to us. I want to say a word or two about that one thing which bears it out, and that is this: I have in probably a dozen or more cases now introduced a large amount of wire into abdominal thoracic aortic aneurisms and have never been able to produce anything like a large blood-clot, even with the added use of the electric current. I take it that my wire was aseptic. That is a simple bit of evidence in keeping with Dr. McLean's experiments.

I am very much impressed by the work that Dr. Rosenow is doing, and particularly with the work he has presented to us tonight. I think it is going to make very much clearer many infections which before have appeared very dark to us. As I said at a recent meeting before the Surgical Society in a discussion on duodenal and gastric ulcer, I believe the time will come when the etiology of duodenal ulcer will be quite as clear to us as we think the etiology of osteomyelitis is today.

One practical word in regard to the value of the work in post-operative thrombus: I think we can accept the proposition that a post-operative thrombus is an evidence of infection. It is not altogether simple. I do not think we can satisfy ourselves with the mere statement that it means infection and that alone, because as Dr. Rosenow tells us there are hundreds of cases where infection will persist for weeks and no thrombus develop. I am speaking now to the surgical members of this gathering. In such a discussion as we have heard tonight on thrombosis, I think we should accept the fact that we have in a thrombus the possible evidence of infection, in spite of the fact that in most of these cases they occurred in what seemed to be clean cases surgically.

I believe it should lead us to greater refinements in our technique for one thing, and in the other to attempt to exclude every source of infection, if possible, before the patient is operated on. That is the moral that surgeons must be taught from the great bit of evidence that post-operative thrombi are infections.

Dr. M. L. Harris: I have been especially interested in what Dr. Rosenow has said regarding the elective action of the bacteria which he has cultivated from these various lesions. There is one fact which I obtained from his figures, which is of interest and shows that all of the organisms still have a common affinity, if we may so express the term, and that the elective affinity must be something very recently acquired and easily lost. If we will look at these figures and add them up, we find he has injected 301 animals with the organisms which he isolated from the various regions and injected both immediately and later; and we find of 301 animals, there were 247 with lesions of the heart and joints, showing that more than 80 per cent of the cases had the heart and joints affected, so that all of these organ sms have a common elective affinity for these particular regions and that the special affinity must have been something recent and of late formation. As to the cause of that I do not know. It is purely speculation until we can have further light from the remarkable work which Dr. Rosenow is doing. But that fact is interesting enough to present.

Dr. Angus McLean (closing the discussion on his part): We believe that in order to have these thrombi develop, an abnormal condition of the blood must be present; that is, if you injure the intima of a vein, and the circulating blood is absolutely normal, you will not get a thrombus; if on the other hand there is a toxin or some infection present a thrombus might form at the point of injury, the injury being, as it were, the selective point for that toxin or bacterium to cause the formation of the thrombus. In all old cases where you have had a long-continued focus of infection, you will always find bacteria or their toxins circulating in the blood upon which the thrombus formation essentially depends.

Injury to the intima of a vessel is not always necessary for the production of a thrombus. If injury were an essential factor then thrombi ought not to form in the lateral sinus either before or after mastoid operation. Here there is no injury of the vessel, the infectious material

gains entrance through the walls of the lateral sinus (i.e. from without inward), and yet a thrombus not infrequently develops. That these thrombi are infected their own clinical course demonstrates; for if left alone, an abscess will either develop at the site or they will give rise to metastatic abscesses.

When a thrombus develops from a small or trifling injury to the intima, there is something abnormal in the individual in whom it develops. A person thus afflicted has a focus of infection somewhere n his or her system. This focus of infection may be an old abscess, a pyorrhœa, a pelvic cellulitis degenerating fibroid, etc., etc. Simple injury alone will not cause the formation of a thrombus.

Dr. E. C. Rosenow (closing the discussion): I grant that other lesions occurred as pointed out by Dr. Harris, but these were slight and transient, and no greater than might occur unrecognized in many cases of the same disease in man. Moreover, part of the incidence of lesions in other organs than the ones for which the strain had elective affinity and from which it was isolated as shown in the table, is due to the large size of the dose. When the dose was properly given in individual series of experiments it was not so marked. The tendency to infect electively the organ from which isolated is least stable in the strains from appendicitis, retaining the tendency only for several subcultures, while the ones from cholecystitis retain it for a longer period. All lose it on animal passage as well as on artificial cultivation.

CORRESPONDENCE

THE FALLACY OF AIR EMBOLUS AS A CAUSE OF DEATH IN OBSTETRICAL AND SURGICAL CASES

To the Editor:

I practically agree with F. Jijin on "Air Embolus in Obstetrics" (*Die Luftembolie in der Geburtshilfe*), *Journal of Obstetrics and Diseases of Women*, St. Petersburg, 1914, xxix, 341, abstracted in the *International Abstract of Surgery*, October, 1914.

Jijin in a critical review of the cases published in obstetrical literature recognizes only three cases as authentic, one each of Olshausen, Swinbourne, and Litzman, and these I do not think are conclusive.

Jijin claims that "only an autopsy undertaken with necessary care with complete macroscopical and microscopical examinations of the organs should be regarded as sufficient evidence for a diagnosis of air embolism." And then I do not think that the pathological findings will justify the conclusion that death is due to air embolus.

In animal experimentation upon ætherized dogs, I have shown that one can inject with impunity large or small quantities of air directly from a five to twenty-five ccm. syringe into the veins or arteries with practically no effect upon respiration or upon the heart-action in rhythm or blood-pressure, the latter shown by using a mercury manometer.

When air is injected into the veins a mere click or adventitious sound is heard over the heart with the stethophone as the air passes through the ventricle. Upon reaching the lungs the air is apparently dispersed.

The air-injected animals killed shortly afterwards by injections of magnesium sulphate solutions afforded no evidence of air embolism.

In repeated injections using 1 ccm. to 25 ccm. of air thrown directly into the dissected out vertebral artery of ætherized dogs from a 25 ccm. syringe that the air might be carried to the cerebral vessels, the slight reactions shown were only momentary and of no moment however.

E. Wever states[1] that the presence of air in cerebral vessels may cause clinical pictures of varying gravity from transient nausea, vomiting, transient blindness, brief paresis, or brief cramps to actual epileptic seizures, or patient may die suddenly without any premonitory symptoms. He states that the apparently constant sign of cerebral air embolism easily seen on account of the spontaneous mydriasis is the peculiar aspect of the fundus of the eye, striking and typical examples of which he shows in a color plate.

But relying upon my own experience in this regard, I have repeatedly purposely exposed the interior of the uterus to fresh air in the control of post-partum hæmorrhage, and in conjunction with external persistent manual manipulation of the uterus have demonstrated that no woman should be subjected to the danger of infection by packing the uterus. However, by favoring the entrance of air to the uterine cavity followed by firm pressure from without, every case of post-partum hæmorrhage *per se* may be controlled without any fear whatsoever of an air embolus.

Therefore, air embolus should not be regarded as the cause of death but rather some other explanation must besought for.

CECIL C. LAWHORN, M.D.

Milwaukee, Wis.

[1] Beitrage z. Klin. der Tuberkulose, Würzburg, xxxi, No. 2.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., St. Louis, Missouri

THE status of the midwife in America is so entirely different from that in Germany that a textbook on obstetrics for midwives is not likely to find a wide demand in this country. This is not the place to discuss the problem of the midwife. But it is an undeniable fact that among the foreign population in our larger cities a large proportion of all confinements, variously estimated as from one-fourth to one-third, is conducted by women whose training is practically nil. Sooner or later some kind of order will have to be brought out of this chaos, and the man or men who will then write textbooks for midwives will have to fall back on the book[1] before us which for many years has been the classic of its kind. Rarely does it happen that any medical work appears in fifteen editions. Still more remarkable is the fact that its author, the Nestor of German gynecology and obstetrics, has been able to attend personally to all fifteen editions in the fifty-four years which have elapsed since its first publication.

ONLY by taking a bird's-eye view, as it were, of the field of obstetrics is it possible to condense the entire subject into a small-sized volume. A vast experience as an obstetrician and a teacher has enabled Dr. Davis, the well-known author, to write a manual of obstetrics[2] with epigrammatic brevity. Nothing that is essential has been left out; yet the author has found space to include subjects that are not ordinarily touched upon even in works of greater length, such as the medicolegal aspect of obstetric practice, and infectious diseases complicating pregnancy; for instance, typhoid fever, pneumonia, spinal meninigitis. As a handy reference book, the reader will find this work of the greatest value in keeping himself informed as to the latest gains in obstetric science. The selection and quality of the illustrations, however, are not on a par with the excellence of the reading matter.

THIS book[3] has been written by a Hindu physician for the use of "students and junior practitioners in India." The author combines an extensive practical experience of his own with a thorough knowledge of the world's literature on obstetrics. In the arrangement of the subject matter he follows the accepted standard of American and European textbooks. Avoiding all academic discussions on theories, he confines himself to the more practical aspects of obstetrics without, however, losing sight of the sound scientific basis of anatomy, physiology, and embryology. Thus the book must be classed as a thoroughly modern work.

Of greater interest to us is the information regarding the influence of race and climate upon pregnancy and parturition. Menarche in Calcutta among English girls born in India, or those who have lived for a prolonged period under its climatic influences, occurs about one year earlier than among English girls in England. Girls of purely Indian parentage begin to menstruate between two and three years earlier than do English girls born in India, and between three and four years earlier than girls in England. The average age of native girls is 11 years 10 months. The early menstruation in Indian girls has been attributed to precocious knowledge of sexual matters due to an absolute want of domestic privacy, and also to too early sexual excitement as the result of marriage customs in Bengal, where the marriage of girls is rarely postponed beyond the twelfth year.

The effects of the Indian climate, as indeed of all tropical climates, are manifested by lassitude and depression of spirits during pregnancy due to lowered nervous tension and the strain placed on the thermotaxic mechanism by the unusual thermic environment. Phosphaturia during pregnancy is very frequent.

Malaria is quite a common complication but ordinarily has but little influence upon the course of pregnancy; quinine is well borne without causing uterine contractions. Leprosy usually leads to sterility and impotence. If conception occurs, abortion generally takes place at about the third or fourth month. Osteomalacia occurs more frequently in India than in England, France, and America. As to the toxæmias of pregnancy, it is interesting to learn that the excretion of urea in Bengalese is very much less than in Europeans and the occurrence of eclampsia almost twice as frequent among Indians as among other races. The average size of the pelvis in Hindu women is considerably smaller

[1] Lehrbuch der Hebammenkunst. By Prof. Dr. Bernhard Sigmund Schultze. Fifteenth edition. Leipzig and Berlin: Wilhelm Engelmann, 1914.

[2] Manual of Obstetrics. By Edward P. Davis, A.M., M.D. Philadelphia and London: W. B. Saunders Co., 1914.

[3] Handbook of Obstetrics for Students and Junior Practitioners in India. By Kedarnath Das, M.D. Calcutta: Butterworth & Co. (India), Ltd., 1914.

than in whites. The fœtuses are proportionately smaller. The average weight of a newborn Indian child is about 19 per cent less than that of an American or European child in its native land, while the weight of a negro child is only about 11 per cent less than that of a white child born under similar climatic conditions. The skin of Hindu babies at birth presents a dusky, bluish-red hue, but does not at all suggest the dark color which it will assume in the course of a few weeks.

The student of the history of obstetrics will be interested in the brief sketch the author gives of the ancient medical literature of India which covers the period from 1500 B.C. to about the commencement of the Christian era. Indian medicine, which at that time was in the possession of an imposing treasure of empirical knowledge and technical achievement, has found its way east and west along the paths of commerce.

THE modern trend in medical teaching which has largely dispensed with didactic lectures, and instead lays greater emphasis on bedside instruction, has begun to exert its influence upon contemporary literature. As far as gynecology and obstetrics are concerned, Liepmann of Berlin was the first to incorporate the new principle in book form; and now DeNormandie has followed with a textbook on obstetrics.[1] The term "textbook" is, perhaps, not appropriate in the sense in which we ordinarily use it. The book is divided into twenty-seven sections which deal with practically all the problems in obstetrics that the practitioner might encounter. A few of the headings taken at random will illustrate the point: Diagnosis of pregnancy; miscarriage; normal pregnancy; forceps; prolapsed cord; nausea and vomiting of pregnancy; breech delivery; face presentation; mastitis; heart disease in pregnancy; contracted pelvis, etc., etc. The twenty-eighth and last section is devoted to the management of the baby. Each subject is represented by one or more case reports according to the frequency, variety, and importance of the condition under consideration or the number of therapeutic measures required. Each group of case reports is followed by a summary in which the author discusses important points in diagnosis, prognosis, and therapy of the respective conditions.

It is thus seen that the book reproduces accurately the method of clinical instruction before a group of students. No attempt is made at style; but what the book thus loses as a literary production, it gains in spontaneity and directness. An enthusiastic teacher speaks here directly to his audience. A stenographer might have taken down the author's remarks and published them without his knowledge. From beginning to end, the book is individualistic. It brings nothing that the author himself has not observed or tested, and so vivid is his gift of expression that one does not notice the absence of illustrations. One is fascinated by the ease of description and the clearness with which the salient points of each case are brought out. Very often the expressions used are those of the patient herself, and one reads chapter after chapter pleased to find that an old and at times rather dry subject has been served to us in so refreshing a manner. We need not always share the author's views. We may, for instance, not like his particular technique of cæsarean section by incising the uterus and then enlarging the incision by "tearing upward and downward"; but on the whole his methods are such that any conscientious physician may safely carry them out.

These "Case Histories" do not substitute the regular textbooks—rather do they supplement them. They will be of the very greatest value to the general practitioner who may not always be in a position to consult with a specialist. Their study cannot fail to interest the reader and to stimulate him to seek a higher standard in his obstetric work. It is a pleasure to greet the volume with our warmest recommendation.

[1] CASE HISTORIES IN OBSTETRICS. Groups of cases illustrating the fundamental problems which arise in obstetrics. By Robert L. DeNormandie, A.B., M.D. Boston: W. M. Leonard, 1914.